THE ADMINISTRATION

OF

INDUSTRIAL ENTERPRISES

WITH SPECIAL REFERENCE TO FACTORY PRACTICE

BY

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PREFACE TO REVISED EDITION

The present revision of this text has been a thorough one. As an illustration of the evolution of the subjects dealt with, it may be said that the new material now presented exceeds in quantity the subject matter of the first edition.

The purpose of this book is to present in compact outline a survey of the state of the art of business management as it exists in the United States, at this time.

The treatment aims to present practice with reasonable fullness of detail but, wherever possible, to deduce and formulate the general principles, or the philosophy, controlling action.

The chief outstanding characteristic of this book is the inclusion, for the first time in such a treatise, of a full discussion of the underlying general principles of administration, which govern all efficient joint enterprises whether of a business nature or otherwise. The reader is earnestly advised to ground himself thoroughly in these principles, for upon them rests the larger part of the executive policies and practical rules employed in business enterprise This material is to be found in Chapters VII—The Administrative Organization, VIII—Administration. Orders and Rewards, IX—Rules of Administration, and X—Morale and Leadership

Other features of this book, to which special attention is invited, are. a careful restatement of scientific management, indicating the real source of union antagonism (Chs. XI, XII); a presentation of the newly-developed subject of employment management, with materials upon mental tests, trade tests, job analyses, and rating scales, which were developed by the Committee on Classification of Personnel, and used in the United States Army during the World War (Chs. XVII, XVIII); an analysis of the elements involved in wage bargaining, together with new material on wage payment plans (Chs. XIX, XX, XXI); and, under the heading " The Selling System," a discussion of the problems involved in setting manufacturers' prices (Ch. XXIV).

The chapter on Fatigue embodies new material recently made available by the researches of the British Health of Munition Workers Committee, and the British Industrial Fatigue Research Board.

The chapters on Location and Traffic (IV and XXVI), taken together, present the geographies of time, cost, power supply, labor supply, and competitive intensity, which must largely supplant the concepts of physical geography in the executive's calculations.

In connection with Purchasing (XIV) the use of scientific specifications is emphasized, and illustrative material is drawn from the work of the Federal Specifications Board.

What was said in the preface to the first edition still holds good, namely. "Throughout this book two things have been held in mind: to trace the application of the scientific method in industry, and to point out the efficiency and the charm of an economic policy based upon welfare and service."

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CHAPTER I

THE NEW METHOD AND THE NEW SPIRIT

The history of the last century of American industry considered from the point of view of the evolution of methods of business organization and management, may be divided into four periods, namely, those of the pioneer, of the inventor, of the captain of industry, and of the modern professional executive.

The Pioneer Period.—The first period was, for the eastern portion of the United States, a time of mixed farming and petty shop-keeping, made significant by the gradual growth of the shops of mechanics into small manufacturing establishments, and enlivened by the dashing seamanship and venturesome foreign trading of the merchant marine. In the West it was the day of the pioneers who wagoned their way to the frontier, built cabins of logs, cut down the timber, split the rails for fences, cleared the fields, surveyed the roads, established local governments, and did all the many kinds of heavy work required to convert the wilderness into a habitation fit for civilized man, and to make simple beginnings in the basic arts and crafts.

For a long period, economic growth meant the mere spread of the settled area westward, with increase of population, and enlarged totals of production, and the multiplication of business units on the same plane of method and purpose. Throughout the country there prevailed a condition of individualistic effort. Every man's business was his private affair Methods were crude, and reputations were local. It was rather good health and native

shrewdness which brought success than systematic knowledge or far-reaching policies. As the times were slow-moving, they called for patience. As the methods were those of trial and error, they emphasized tenacity of purpose. The economic virtues extolled were self-reliance and such basic things as industry, economy, and freedom from debt

The representative thinker of this period was Benjamin Franklin, whose terse sentences, put into the mouth of "Poor Richard," expressed the prevailing philosophy of the day. The most widely known sentence of Franklin is, "Honesty is the best policy." Of debt he said, referring to imprisonment for debt, "Think what you do when you run into debt; you give to another power over your liberty." He both practiced and preached frugality and industry. "Take care of the pence, the pounds will take care of themselves." "A small leak will sink a great ship." "It is hard for an empty bag to stand upright." "A shilling spent idly by a fool may be picked up by a wiser person who knows better what to do with it: it is, therefore, not lost." "Diligence is the mother of good luck." "The used key is always bright." "He that lives on hopes will die fasting." "Since thou art not sure of a minute, throw not away an hour." "The way to wealth is as plain as the way to market. It depends chiefly on two words, industry and frugality." Thus was laid what may be called the foundation course of the structure of business policy,—laid with maxims of an emphatically personal system of economics.

It is not to be thought that the pioneers were without visions. Their circumstances were cramped, but their thought went freely forward to a far-distant future when their children should reap where they had sown. The victory was not to mere parsimony and patience, and the weaker economic virtues, but to industry animated with boldness, planning touched with imagination, and sacrifice sustained by a vision of a new state and a fairer civilization.

The Period of the Inventors.—The second period was inaugurated by the inventors and builders. A small group of colonial inventors, including Fulton, Franklin, Eli Whitney, Samuel Slater, John Stevens, and that universal but neglected genius, Oliver Evans, struggled against the handicaps of crude apparatus, small capital, and defective patent laws. With the coming into prom-

ience of such men as Thomas Blanchard, S. F. B. Morse, and Elias Howe, there began a succession of mechanical geniuses which has been continuous to the present day. To it belongs Peter Cooper, iron manufacturer and builder of the first American locomotive, Geo. H. Corliss, the perfecter of the steam engine, Obed Hussey and Cyrus McCormick, inventors of the reaping machine, James B. Eads, first American builder of iron-clads and great steel bridges and the inventor of the jetty system, Alex. L. Holley, perfecter of waterworks machinery, and John Ericsson, inventor of the screw propellor and the hot-air engine and builder of the *Monitor*. To them, and men like them, it is due that the canals and trunk railways were built, that agricultural implements were devised to handle the immense farm areas of the West, that the colonial iron-working shops grew into factories, that the principal machine-tools were perfected to accurate and semi-automatic operation, and that the principle of interchangeable mechanism was perfected and given to the world. "The first billet of Bessemer steel was produced in America in a little furnace at Wyandotte, near Detroit, in 1861. The first band-saw was brought from Paris to New York in 1869. The first middlings purifier, essential in the milling of hard wheat, was built in Minneapolis in 1870. The twine-binder was invented in 1874. In the wonderful centennial year of 1876, there were given to the country the telephone, the incandescent light, the typewriter, and the first steel-frame building. In the middle years of the seventies the hermetical sealing and the refrigeration of fruits and meats were achieved, so that a great additional range was possible for the dietary of the nation." [1]

These inventions increased the speed with which the virgin resources of the frontier could be exploited. Inventive genius revolutionized the mechanism of farming and lumbering, and made possible a speed and scale of operations which soon transformed the western farmsteads into something like the southern plantations,—but with machines as slaves,—and developed the saw mills from local custom shops into factories producing standard articles for distant markets. The early successes with mechanism created such a conscious pride in the nation's inventive genius that suc-

[1] The Business Administrator, Edward D. Jones, N. Y., 1914. The Engineering Magazine Co.

ceeding steps in industrial progress developed the railroad amazingly on its mechanical side, and forced from infant to adult state all that class of manufacturing which depends chiefly upon machinery.

The Period of the Captains of Industry. – While the attack upon the frontier, gradually advancing from the Middle West to the Far West, was still going on, and while inventing and the application of engineering control were being pursued in a thousand ramifications, the combination of great natural resources and labor-saving mechanism, when brought together in the hands of men of great personal force as leaders, began to produce results in the way of powerful business enterprises and great private fortunes, such as the country had never before seen.

Our first generation of great executives is often referred to as the "Captains of Industry." This title is derived from Thomas Carlyle's "Past and Present," and from the sentence (Book IV, Chapter IV) in which he says: "The leaders of industry, if industry is ever to be led, are virtually the captains of the world; if there be no nobleness in them, there will never be any aristocracy more." Upon these men was set an economic task of perplexing variety.

Most of them were obliged to earn their own way from an early age. With little schooling, they picked up the rudiments of a general and trade education as they went along. They gathered together the small savings, and then the larger profits, by which their fortunes were consolidated and their economic power as proprietors acquired. As their interests grew, and while under the pressure of current duties, they had to learn by experience the executive's art, and catch such glimpses as they could of the underlying principles of administration upon which that art rests. To do all these things, and do them so well that the solutions could set a new standard was so difficult that few, even of our richly gifted race, achieved notable success. Such a struggle called not only for all-round genius, but for an aggressive temper like that of the knights of the Middle Ages, or the condottieri of the Italian Renaissance.

From the many who endeavored, there were a few who emerged to eminence, by reason of a fortunate juncture of circumstance and talent. The names of such men as William Morris, Stephen Girard, A. T. Stewart, George Peabody, J. J. Astor, Cornelius Vanderbilt, Jay Cooke, Oakes Ames, Henry Villard, J. J. Hill,

Andrew Carnegie, Philip Armour, C. P. Huntington, and Marshall Field have become a part of American industrial history.

"The captains of industry seized leadership by right of ability but, technically speaking, they secured it as the privilege arising from the ownership of great fortunes. They lived in a day when men generally managed their own capital. Living in a highly individualistic and self-confident society, they worked out rules of action, each man for himself. As their communities had broken sharply with European traditions, and had as yet little applicable history of their own, they entertained a poor opinion of lessons drawn from the past. As they were devoted to little else than industry, they saw few analogies between the administration of business affairs and the administration of other forms of social action.

"Being so much in a world of their own creation, they looked upon the administration of industrial enterprises purely as a process of each man minding his own business. Their organizations were, therefore, mere extensions of themselves, usually bearing their names, and ruled as their households might be. Enterprises so conceived were incapable of serving as a rallying-point for the loyalty of the various classes of persons who might become connected with them, so that persons of ability who worked for them saw no career other than through establishing businesses of their own. The owner alone was fully energized. He carried staggering loads of responsibility, driving affairs forward by individual energy, rather than by the true administrative process of evoking and guiding the energies of others.

"Whatever reservations have to be made in praise, the courage and independence of these men must be recognized as splendid. They possessed a thorough mastery of details, as a result of the small beginnings from which they had started. They had the ease and speed of decision due to technical mastery and early imposed responsibilities. They were preserved from many errors of theory by a wholesome and intimate sense of reality" [1]

The captains of industry doubtless increased the productive power of the country very greatly; but their preoccupation with personal profit, and their lack of social sense, caused them to pile

[1] The Business Administrator, Edward D Jones, N. Y., 1914. The Engineering Magazine Co.

up problems which it has taken the better part of a generation to bring under reasonably complete control. The period extending from 1900 to the present may be considered transitional in character. It has been engaged in two great enterprises. the clearing away of the wreckage left by the captains of industry, and the laying of the foundations for a new industry to be based upon scientific law, professional pride, and social service.

The Beginnings of Science in the Administration of Industry.—If it is permissible to mention a particular date, in connection with movements of an evolutionary character, it may be said that, from 1900 on, there began to be apparent, in American industry and commerce, a new method and a new spirit. Something of this change can, perhaps, be traced to the influence of Theodore Roosevelt, whose stirring call to young men to devote themselves to great causes, and whose vigorous combat with evil in high places, changed the temper of American thought. More can be attributed to the quiet, pervasive influence of the engineers who rose to executive positions in industry. The engineers were the first systematically trained men to be introduced, in any considerable number, into the ranks of American executives. Their knowledge of science, their respect for fact and law, their thoroughness in investigation, their objective temper, and their professional pride—pride not so much in profits as in the fine art of the method—were new and needed in industry. Chiefly, however, the change must be attributed to changed conditions.

The literature of business organization and management, which was a magazine and trade convention literature until the manuals appeared after 1910, was from the start roughly divisible into four categories, that pertaining to accounting and office methods, that having to do with equipment and physical processes, that setting forth the charm of welfare activities, and that which mirrored the contest of interest and opinion with reference to rival marketing processes.

Parallel with this literature, but involving a distinct group of interested persons, was that on welfare. Stimulated by the progressive activities of such firms as the National Cash Register Company, The Procter and Gamble Company, The H. J. Heinz Company, The International Harvester Company, The United Shoe Machinery Company, The Colorado Fuel and Iron Company,

and others, there appeared in steady volume from 1904 on, discussions having to do with the comfort and peace of mind of the employee.

The literature of marketing appeared with the advent of the popular magazines in the middle nineties, for these provided the avenue for national advertising campaigns, and brought into prominence a new class of manufacturers interested in specialized merchandise, identified by trade marks and trade names.

There can be no doubt but that after 1910, when the railroad rate hearings brought it to public attention, scientific management became the center about which practically the entire subject of business organization and management revolved. There was, in 1911 and 1912, a great outpouring of books and articles upon it. Since that time there has been a steady discussion of the principles, and of additions to them, or extensions of them to new functions or new lines of business.

The World War enormously emphasized collective control and comprehensive planning. It made every form of waste and inefficiency a crime, and it greatly expanded the definition of what constitutes waste It enhanced the value and the advantage of the trained man, and it enforced economy in the use of every type of skill No branch of business practice received greater impulse from the War than that which has to do with the administration of the human factor. Methods of selection were developed by the Committee on Classification of Personnel of the United States Army, including mental tests, trade tests, and the rating scale; all of which are now available for use in industry. The health of the worker was safeguarded by the formulation of shop sanitary standards, and by agreements as to hours of work, and as to the employment of women in industry. Medical supervision and physical examination were introduced rapidly as standard practice. In order that programs of production might be carried forward without the interruption of labor turnover or strikes, the various administrative functions which are now embraced under the term employment management were given extensive application; and programs for the training of men in the basic principles of employment management were successfully carried out, in record time, on a large scale. The literature of employment management has appeared in great volume since the begin-

ning of 1916 The War emphasized "democracy" in the government of business, and candor to replace "secret diplomacy" between management and men, as to every feature of the industrial relation. From England was brought the suggestion of the Whitley councils. This has been promptly utilized here in the shop committee movement.

The War, so to speak, made a quick and pungent appraisal of the existing science and art of business, probing every weak spot, and bringing sharply up to the mark every laggard department of practice. At its close American business was left as different from what it had been in 1900, as if a new world had been created.

The Professional Administrator.—Professor W. J. Ashley said in 1900: "The United States is in a far more dynamic condition than England: methods of industry are more rapidly changing and industry is continually moving into new territory. But in a highly dynamic society the functions of the business entrepreneur approach their maximum of importance; and the more important the function of the entrepreneur the more highly developed, inevitably, is industrial individualism." [1] In America tradition and custom are so slight a force that all policies are brought constantly into corrective contact with the ultimate test of efficiency. Here the large scale of operations acts as a sort of microscope upon the economic tissue, enlarging functions, and intensifying the significance of administrative agencies, so that the possibility of systematic preparation, scientific control, and of the formulation of the rule of action as a principle, is seen, while in small affairs men are thwarted in their analysis, and rely upon uncritical "experience," instinct, "the hunch," and depreciate more careful methods as "mere theory."

In America the economic evolution has been so rapid and so dynamic that all men have seen the future as a mysterious and thrilling possibility. The enormous domestic market looms in the background of every proposed plan. Hence enterprise has an element of the dramatic. Such a world of business has attracted men of imagination. It has seized the attention, aroused the faculties, and challenged the value sense of every man of vision to prove himself equal to the occasion.

[1] Surveys Historic and Economic, W. J. Ashley, N. Y., 1900. Longmans, Green & Co., p 412.

The work of the administrator is beginning to be separate enough from that of the capitalist so that it is possible to perceive that the true art of administration is a thing which is in many ways distinct from the current process of acquiring a private fortune. We have long been familiar with the distinction between labor and capital: the two elements thrust widely apart by the introduction of the factory system. But we have not so clearly seen that this system is separating the administrator from the capitalist. So long as we have thought of owner-managers, we have confused administration with the economist's "risk-taking," and the business man's "money-making."

For the present, no doubt, the administrator looks upon himself chiefly as the representative of the investors, and takes the traditional capitalistic attitude. But he is fast awakening to a consciousness of his distinctive function, and is learning to think independently, and formulate standards which are purely administrative The administrative group finds itself in a pivotal position as the trustee of the property of investors, as the teacher and leader of the operative force, and as a delegate responsible for the preservation of certain public interests.

When many persons become conscious of their life work as a form of art, or as a social service, and when their devotion to this work is intensified by the knowledge that many others, in the same field of endeavor, are united with them in a sort of invisible brotherhood, it is possible for their personal pride in individual achievements to be so broadened and elevated by consciousness of class that it becomes professional pride. This feeling, which is so marked among scientific workers, has been, hitherto, but little developed in industry, for industry has had to contend with infinite diversity of institution, and with methods which were the progeny of tradition and makeshift. As a result of the movement to introduce scientific methods we may hope to see an industrial practice arise which, from its precision and appropriateness, will exert a charm as a true art, and will therefore provide a new center of interest to stand alongside the profit of the result; namely, the elegance of the means. As professional pride appears among business men we may be sure that two conditions are observed, for they are the bases of professional feeling, namely, that methods

are based upon a body of principles, and that ultimate aims are dignified by the motive of social service.

Of these matters as they manifest themselves in English industry, Mr. H. G. Wells has said in his *New Worlds for Old:* "One can only appeal to the intelligent reader to use his own personal observation upon the people about him. Everywhere he will see the property-owner doing nothing; the profit-seeker busy with unproductive efforts, with the writing of advertisements, the misrepresentation of goods, the concoction of a plausible prospectus, and the extraction of profits from the toil of others, while the real necessary work of the world,—I don't mean the labor and toil only, but the intelligent direction, the real planning and designing and inquiry, the management and the evolution of ideas and methods,—is in the enormous majority of cases done by salaried individuals working either for a fixed wage and the hope of increments having no proportional relation to the work done, or for a wage varying within definite limits. All the engineering design, all architecture, all our public services, the exquisite work of our museum control, for example, all the big wholesale and retail businesses, almost all big industrial concerns, mines, estates, all these things are really in the hands of salaried or quasi-salaried persons. . . . They are only possible now because all these managers, officials, employees, are as a class unreasonably honest and loyal, are interested in their work and anxious to do it well, and do not seek profits in every transaction they handle. Give them even a small measure of security and they are content with stimulating work; they are glad to set aside the urgent perpetual search for personal gain that individualists have persuaded themselves is the ruling motive of mankind; they are glad to set these aside altogether and, as the phrase goes, 'get something done.' . . . Self interest never took a man or a community to any other end than damnation. For all services there is necessarily a code of honour and devotion which a man must set up for himself and obey, to which he must subordinate a number of his impulses. The must is seconded by an internal imperative. Men and women want to have a code of honour. In the army, for example, there is among the officers particularly, a tradition of courage, cleanliness, and good form, more imperative than any law; in the little band of men who have given the world all that we mean

by science, the little host of volunteers and underpaid workers who have achieved the triumphs of research, there is a tradition of self-abnegation and of an immense, painstaking, self-forgetful veracity. These traditions work. They add something to the worth of every man who comes under them." [1]

The business administrator is so centrally set as an agency of progress that, taken at his best, he may be confidently recognized as the representative man of action of the age. As such, he is the spiritual descendant of a long line of administrators of former ages, —the tribal leaders, spiritual princes, and knights-at-arms of past time A new profession, and something more than a new profession, is in our time being produced. As it emerges there comes forth from sifted and classified experience the first principles of a new science of administration, in the light of which the administrator begins to understand the possibilities of his position These new principles are welcomed by those who have imagined the ideal and are eager to find the means for its realization They are welcomed by public opinion, which through multiplied interference with the doings of the superman as a mere money maker, has testified to its anxiety for a new day of more liberal leadership.

What is gradually making itself clear in economic evolution is that business administration is outgrowing the limits of private affairs, and is becoming a branch of a much broader art of administration of the interests of society. It may, therefore, look for inspiration in a wider field, and turn with profit to the history of all forms of joint effort. Military strategy will yield to it rules for strenuous efficiency; statesmanship will sketch for it a broad philosophy, diplomacy will impart the secret of attaining harmony. Profitable study may be given to the methods in war of such men as Frederick the Great, Napoleon, Wellington, Von Clausewitz, Von Moltke, Lee, and Grant. In statesmanship the principles of Machiavelli, Richelieu, Peter the Great, Pitt, Bismarck, Cavour, Washington, and Lincoln will demand consideration. In diplomacy the balance and finish of Sir Philip Sidney, Castiglione, Chesterfield, Metternich, Talleyrand, and Hay will challenge the emulation of the business leader. And so the executive engaged in industrial affairs may be brought into that great

[1] From New Worlds for Old, by H G. Wells, copyright by The Macmillan Company, 1908

company of leaders who, as Goethe says, "by deeds and actions give laws and rules."

The student of the executive art may perceive, in such men as Napoleon, an astonishing mastery of detail, coupled with weakness in tolerating no advisors of independent mind at this court. Unshakable decision may be seen in Lincoln, while in the pages of Guicciardini he may read of the fatal irresolution of Clement the Seventh.

For the effects of concentration upon principal aims he may review the life of Grant; while Lord Brougham will provide the picture of scattered energies. On compromise and the middle course Sir Henry Savile can teach him: while Chatham will serve as an illustration of a statesman ready for extreme measures. In Robert E Lee he may observe the function of religious faith in easing the mind of anxiety after duty is performed. Efficiency in defeat may be illustrated by Wolsey's extraordinary fertility of invention, Richelieu's power of making the most of all circumstances, Mazarin's cool objective temper, and Beaconsfield's courage.

If he wishes to study the talents which reveal themselves in speed of execution, there is the story of Sir Henry Vane's construction of the English navy under Cromwell, while the philosophy of judicious delays extends from Fabian to Joffrey. On the choice of men Cromwell gives us the grand test of moral force, saying, "I raised such men as had the fear of God before them, and made some conscience of what they did, and from that day forward, I must say to you, they were never beaten."

If he would learn how proper limits may be set to effort, there is the history of Frederick the Great, who never overreached himself, while, contrariwise, in the policy of Laud and Strafford, denominated by the word "thorough," and in the answering "root and branch" of the Parliamentary leaders, he may observe the stern virtue of avoiding half-measures overstepping practical limits.

In Wellington's career he may trace, working together with immense capacity and devotion, the results of aloofness, and indiscriminate praise and blame, and finally, in his political life, intolerance; while Julius Cæsar, that predecessor whom he resembled in arms, challenges his admiration for his art of making common

cause with his men, his astonishing power of searching out and rewarding those who deserved praise, and his leniency where the motives of his opponents were honorable.

The literature of administration, with which the student who aims at the highest things should strengthen his mind, is vastly wider than the literature of business administration. First of all, there is biography, infinite in amount, from ancient Plutarch to modern Bradford, writing of *Lee, the American*, and varying in quality from the stern stuff which came from the heavy hand of Carlyle, to the light workmanship of La Bruyère and Sainte-Beuve. For the study of benevolent tyrants—or the benevolent study of tyrants—there are Mommsen's chapters on Sulla and Julius Caesar. For the rôle of intuition as an aid to leadership, there is Monypenny's *Disraeli*. For tenacity of purpose there is Thayer's *Cavour*. It is well to seek out the great analyzers of human motives, such as Samuel Johnson, Bacon, Bulwer, Goethe. and Emerson.

The philosophy of joint action may be found in the wisdom literature, extending from *Proverbs* to Bacon's *Advancement of Learning*. There is much of it in such maxim writers as La Rochefoucauld and Chamfort, as well as in the aphoristic paragraphs of Goethe and Schopenhauer, and of the wise Spanish prelate Belthasar Gracian. Besides these, there are pertinent treatises by lesser men not to be overlooked, such as Sir Walter Raleigh's *Cabinet Council*, John Foster's *Decision of Character*, Lecky's *Map of Life*, and Sir Arthur Help's *Essays*.

The early literature of political science, before modern constitutions so greatly hedged the executive about, is suggestive. And especially thought-provoking is the literature of the Renaissance, when the principles of politics were in such a formative and unreconciled state as the principles of business administration are now. And here there is particularly to mention the writings of Machiavelli. It is well to accompany the study of the products of this penetrating mind with the explanations of Morley, Villari, and Lord Acton.

Military science deserves careful attention, for it is, at present, the most highly developed branch of administration, with the possible exception of political science. It differs from the latter in that little sacrifice of efficiency is tolerated for the sake of demo-

cratic distribution of power. The emphasis which this literature places on the rugged virtues imparts to it something of the strength of soul of the classics. The great work in this field is that of General Karl von Clausewitz, the father of German strategy. It bears the simple title *On War*. The writings of the officers of the general staffs of Germany, France, England, and the United States constitute a reliable body of professional treatises, the general tone of which is surprisingly broad and philosophical. In this field the student is advised to begin with Lieut.-Col. Lincoln C. Andrews' *Leadership and Military Training* [1]

To offset the influence of studies from war, the student may turn to the literature of art, especially of that portion of it which considers art as a phase of self-expression, and as a source of pleasure in work. Here two names suggest themselves at once: John Ruskin and William Morris.[2]

The Scientific Method.—We have said that one of the chief objectives of American business evolution, during this generation, has been to base its operations more and more upon scientific law. Industry is the greatest exponent of action in modern life: science is the chief exponent of modern thought: much is to be hoped from the union of the two. The contrast between the efficiency of science and the inefficiency of tradition has been so strikingly illustrated in medicine and surgery, and in warfare, that the inference can no longer be repressed that science can likewise help industry onto a higher plane of efficiency. In a couple of decades the general attitude of business men toward science has changed from neglect or distrust to profound respect.

Already there has been convincing contact between science and industry. Science has devised many new processes and compounded new materials and constructed useful instruments of precision. Some one of the many branches of engineering now reaches almost every industry. Already the geologist directs the miner, while the lumberman begins to respect the forester, and the farmer asks for the appointment of a district

[1] Leadership and Military Training, Lincoln C. Andrews, Philadelphia, 1918 Lippincott.

[2] See further, Education and Industrial Efficiency, Edward D. Jones, Proc of 27th Annual Meeting of the Am. Economic Assn., 1914, Vol. V, pp. 215–226.

adviser who has been educated at an agricultural college. As men of scientific training, the engineers are having a wide range of administrative duties thrust upon them, while in the demand for trained accountants and actuaries and employment officers, may be seen a hunger for scientific control which has become keen in all departments of practical action. The general advance of practice is betrayed by the multiplied use of laboratories and planning rooms, in the rapid rise of a literature devoted to the search for principles applicable to industry, in the growth of university courses in business administration, and in the multiplication of scientific societies for various classes of industrial experts. We have already witnessed the formulation of a body of intelligent administrative principles for the control of the raw-material industries, as the result of the conservation movement, and of the code of rules known as scientific management, for application to manufacturing institutions. The restlessness now expressed with the wastes of marketing promises to bring the distributive industries increasingly under scientific scrutiny The present movement signifies that all the problems of industry—administrative, commercial, and financial, as well as those of a physico-technical character—are to be looked upon as problems of science, to be investigated with the care and thoroughness heretofore characteristic of scientific research only.

Pasteur was once asked by an associate what scientific reasoning was His answer was. "Simply this: reasoning exercised with the salutary fear of self-deceit, and the firm resolve to avoid it"

The scientific method differs from ordinary thinking in degree rather than in kind It may be briefly described as the orderly, persistent, and thorough use of the mind a sort of sublimated common sense It may be more fully described by dividing it into steps, as follows

1. The analysis of the facts, problems, or conditions, which are made the subject-matter of study, into their elements, to improve the ratio between the difficulty of the subject and the natural vigor of the investigating mind, and to insure the collection of data in a form sufficiently disintegrated to be manageable. President W D Scott, in one of his books says, "It is a general law of psychology that all things tend to fuse, and only

those things are analyzed that must be analyzed. . . . We do not at first perceive the parts and unite them to form the greater wholes, but we first perceive the wholes, and only after the process of analysis has been completed do we perceive the parts."[1]

2. A very complete, and even exhaustive collection of data, sufficient to make it certain that the law of the subject is fully recorded, and to reduce accidental errors and other variations due to chance to a negligible, or at least to a definitely calculable, percentage

3. The classification and arrangement of facts in such a telling manner as to show all significant agreements, differences, and concomitant variations between them, so that everything may be brought to bear clearly and definitely in answer to a given question, and so, also, that the juxtaposition of ideas will finally lead the mind to take the fourth step.

4 The making of inferences, or the drawing of conclusions, from the facts by induction, deduction, analogy, or any other logical method, using ingenuity to choose the most effective order and combination of these methods, and imagination to increase to the utmost the vigor and span of the mind.

In inductive reasoning the order of procedure is from the specific to the general, beginning with individual facts and building up to principles Deductive reasoning passes from the general to the specific, showing that principles necessitate certain specific facts, or that restricted principles are contained within those of a more general nature. There is no conflict between the proper functions of inductive and deductive reasoning, the only matter for dispute is their relative fitness in any particular case, considering the nature of the subject-matter, and the character of the individual minds involved. Most persons use induction and deduction in the most intimate alternation.

Analogy rests upon the perception of a like arrangement between the parts of two distinct bodies of truth, and the inference that what is true in one set of circumstances is likely to be true, in some degree, of similar circumstances The value of the analogy lies in the fact that by it certain cases, in which the relations are clear and conspicuous, can be used to familiarize the mind

[1] The Theory of Advertising, W. D. Scott, Boston, 1903. Small, Maynard, pp. 98–99.

with the nature of a relation, so that, when similar phenomena are studied, we are able to detect the presence of the relationship, even though it be subtle and partly hidden in its new form

The inference or new idea which is the product of investigation is not to be permitted at once to exercise full and unrestricted influence upon the judgment, but only such influence as will facilitate the taking of the fifth step.

5. New inferences are to be subject to criticism and test in every possible way, by the use of established facts, to determine whether these inferences are truth or error. Ultimate reliance is placed upon the harmony of all parts of truth with each other, and upon the equal validity of truth for all normally constituted minds.

6. The final step in the scientific method is to hold all conclusions easily and rationally, with open mind for the reception of new evidence

When once a position has been taken as the result of an investigation, the scientific temper exerts itself to avoid dogmatism and undue fixity of opinion. It strives to hold judgment more or less open on all complex matters, so that new truth will be hospitably received, while yet making necessary concessions to the requirements of immediate action through temporary policies or working hypotheses.

Under failure much can be retrieved by a courage which is sufficient to look a situation squarely in the face, and so collect the necessary knowledge for a more successful policy.

Those who think over their experiences, and deduce general conclusions from them, soon raise themselves out of the confusion of specific instances, pass beyond the limitations of rules of thumb, and liberate themselves from the laborious safeguards of mere retentive memory. As the late Professor William James, said. "The best possible sort of system into which to weave an object, mentally, is a *rational* system, or what is called a 'science' Place the thing in its pigeon-hole in a classificatory series; explain it logically by its causes, and deduce from it its necessary effects; find out of what natural law it is an instance—and you then know it in the best of all possible ways A 'science' is thus the greatest of labor-saving contrivances. It relieves the memory of an immense number of details, replacing, as it does, merely contiguous

associations by the logical ones of identity, similarity, or analogy. If you know a 'law,' you may discharge your memory of masses of particular instances, for the law will reproduce them for you whenever you require them."[1]

There are certain qualities of will, and attitudes of mind, and virtues of disposition which are favorable to the use of the scientific method. Aware of the many imperfections of the human mind—cramped as it is by habit, dulled by ignorance, and swept by emotion—the general attitude of the searcher after truth should be watchfulness with regard to himself and tolerance for the mistakes of others. The greedy and anxious person, unduly concerned with thoughts of self-advancement, works with divided aim, the law of the subject and the law of self-interest continually clashing, so that energy is consumed by internal friction The best mental work involves a certain abandonment to the subject, which opens it freely to view throughout its entire panorama without distortion. The perception of truth demands complete eradication of such preconceptions and prejudices as may prevent due allowance for any pertinent fact, it calls for breadth of interest to welcome suggestions from any source, and it requires concentrated attention to make progress by fully comprehending each thing in its turn. The ideal is a fluent, sensitive, teachable spirit.

Problems

The Civil War and American Manufacturing.– In 1869 it was stated in an official document: "Within five years more cotton spindles have been put in motion, more iron furnaces erected, more iron smelted, more bars rolled, more steel made, more coal and copper mined, more lumber sawn and hewn, more houses and shops constructed, more manufactories of different kinds started, and more petroleum collected, refined, and exported, than during any equal period in the history of the country." What was the effect of the Civil War upon manufacturing in the Northern states? What was the extent, character, and location of the leading lines of manufacture—such as iron, cotton, agricultural implements, slaughtering and meat packing, etc.,—in the period 1865–1870?

The Principle of Interchangeable Mechanism.—What is the principle of interchangeable mechanism? When, and in what lines of manufacture, did it develop? What branches of manufacturing has it influenced

[1] Talks to Teachers on Psychology, William James, N. Y., 1899, p. 126.

chiefly? What have been the principal consequences to industry from its introduction?

The Reaction of Industries upon Each Other.—Select an industry, and study the manner in which it has been effected, in recent decades, by the evolution of other industries, such as the iron and steel industry, the machine tool industry, the food industry, the textile industries, the lumbering industries, the clothing industries, the leather industries, the printing industries, the heavy chemical industry, and any industries which are its suppliers, or competitors, or customers Give special attention to what are sometimes called " key " industries.

The Influence of General Industrial Movements.—Select an industry, and study the influences which have been felt in it from the chief movements of modern industrial evolution Among such movements may be mentioned, the rise of engineering, the introduction of industrial chemistry, the utilization of electricity, the spread of the system of interchangeable parts, the introduction of refrigeration and the sealed can, the invention of the telephone, the telegraph, the typewriter, the rotary press, the automobile, and of agricultural implements, the use of structural steel, the introduction of concrete, the advance of precision in the metal-cutting industries, the rise of metallurgy, the introduction of scientific management, the expansion of markets, the development of modern advertising and selling methods, the rise in the cost of living, the exhaustion (at least locally) of various raw materials, the raising and lowering of the tariff, the development of the tropics, the use of the corporation, the opening of the West, the growth of large cities, the introduction of modern plumbing, heating apparatus, and artificial illumination, the inflow (and checking) of European immigration, the World War.

The Contemporary Movement for Efficiency—Select an industry and, from its literature and from interviews and correspondence with leading representatives, make a statement as to the projects for improvement of efficiency which are now receiving the greatest attention, or which, in your opinion, hold the greatest promise Consider engineering control, chemical control, elimination of waste of raw material, economy of fuel, the use of power in new ways, changes of layout or routing, time economies, improved coordination inside the plant or with outside agencies, inspection and quality control, effort to achieve artistic effect, improvement of mechanical equipment, change of location of establishments, improvement in accounting methods, evolution of mercantile aspects, regularization, production on a larger scale, improvement in employment management practice, etc , etc

Underlying General Principles.—Read Xenophon's Memorabilia of Socrates, Book III, Chapter IV, and argue the case for and against the position taken by Socrates.

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CHAPTER II

LAUNCHING AN INDUSTRIAL ENTERPRISE

The Idea.—The first step in the inauguration of an enterprise is the development of the idea that there is a specific business opportunity. This idea may arise from the knowledge of an unused supply of raw materials or an undeveloped invention, from the observation of the inferiority of some article or service now holding the field, from a knowledge that certain firms are making large profits or are turning away business, or from an impression that a favorable opportunity has at length arrived for utilizing the knowledge one has gained of a particular branch of business.

Inasmuch as a sanguine disposition, coupled with youth and good health, makes new ventures seem attractive; and since there is a general tendency for minds which are "made up" to collect only confirmative testimony and neglect opposing evidence, special precautions should be taken in forming the first decisions. So prone are loving relatives to believe that one is capable of anything, and so politic are friends in leaving disillusionment to the course of events, that the business pioneer must create subjective restraints to prevent becoming overwarmed by his own initiative, and to avoid being driven by false pride arising from the consciousness of being publicly committed. One should even go further than this, and search actively for negative influences and unfavorable signs. The records of business failures show that the presumption is strongly against the average new enterprise.

Necessary Persons.—The success of most enterprises is dependent upon the quality of that small group of leading spirits which is free to assert whatever administrative talent it possesses by reason of the possession of full executive authority, and which

is strongly stimulated to exertion by the pledging of estate and reputation. As this group is at first easily formed, but is difficult to alter later on, the original choice of entrepreneurs should be carefully considered. Inasmuch as talents should conform to functions, there should be included in the original group a person able to deal adequately with each important phase of the business. This would ordinarily mean a financial man to take a leading part in raising capital and in keeping the finances in order, a technical expert to plan the processes of manufacture and recommend proper equipment, a selling expert acquainted with the market to be entered, and a general executive able to formulate comprehensive policies and to hold the various lines of specialized effort in proper proportion.

The Market and Its Fluctuations.—In the analysis of the market a variety of questions suggest themselves. What is the present demand for the article? If there is no active demand, as in the case of a new thing, what is the need or potential demand, judged by the relation the proposed product will sustain to present consumers' habits and to articles which are already in use? Is the article a necessity or a luxury? Will it be sold chiefly on price or on quality? Is the industry growing throughout the country? Is this growth rapid or slow, or is it normal, that is to say, a fairly constant function of the increase of population, which may mean an increase of about $1\frac{1}{2}$ per cent per annum? Will the market be steady or fluctuating? The fluctuation of demand which must usually be encountered in supplying a luxury suggests that the production of some staple article, or article in special demand in hard times, be coupled with it. The more distant future of a projected enterprise raises the question of the manner in which the market will be effected by general movements such as the increase of population, a continued rise in the cost of living, the spread of education, the increase of restrictive legislation, any improvement in the means of transportation such as in local trucking or in suburban electric traction, the continued settling of the West, the exhaustion of natural resources such as forest resources in certain localities, etc , etc.

Price Minus Cost Equals Profit.—Examining somewhat more in detail the economic significance of a market, it may be asked, What are the current prices? Has the price been steady in com-

parison with the prices of other articles, or is it working to lower or higher relative levels? [1]

If the prices seem to be very high caution should be redoubled There is usually some catch. This is a country of active and intelligent people, and there is an abundance of capital and administrative talent on the lookout for opportunities, so that anything so obvious as a set of prices conspicuously out of line with normal profits cannot long endure. Investigation of such cases should be directed to ascertain whether demand is not seasonal, or answerable to some non-periodic fluctuation, or whether there is not some unnoticed accompanying free service rendered, or whether there does not exist a trade group of products one element of which alone is permitted by custom to carry the profit which must suffice for the entire group. What is the depth of a market, that is to say, the elasticity of demand under pressure of an increase of supply? What increased productive capacity is in preparation, and due to become effective in the near future?

From prices costs must be subtracted before profits are arrived at. The costs of a young and small establishment are not those of a large and favorably known business It is an easy mistake for the founders of a new business to carry away with them the ratios of the established businesses from which they resign, and to apply these ratios in the estimates of a small concern, which, for the first few years, must carry the extra costs of establishing a going business.

Policies of Dominant Interests.—In these days of powerful corporations and of unrevealed alliances resting upon harmony of interest, interlocking directorates, or joint banking control,

[1] In studying the relative movement of groups of prices, allowance must be made for the general upward trend The record of Bradstreet's Price Index is.

1901,	7 57	1909,	8 51	1917,	15 61
1902,	7 88	1910,	8 98	1918,	18 71
1903,	7 94	1911,	8 71	1919,	18 66
1904,	7 92	1912,	9 19	1920,	18 81
1905,	8 09	1913,	9 21	1921,	11 37
1906,	8 41	1914,	9 00	1922,	12 12
1907,	8 90	1915,	9 85	1923,	13 40
1908,	8 00	1916,	11 83	1924,	12 78
				1925,	13.93

it is wise for a new business to consider the temper of the opposition it may have to encounter Care will be necessary, if the relation of a projected enterprise to a dominant interest will be a weak one, such as to work upon a material which can only be secured from it, or to produce a product which can only be sold to it, or to furnish it with supplies or equipment which its factories use in such quantity that they could keep a plant of their own occupied The history of consolidation shows that the tendency to extend control from a given stage of manufacture back toward the sources of raw materials is greater than to extend it forward into the field of finished products.

Scale of Operations.—The proper scale for initial operations is, in one of its aspects, a function varying with the degree of certainty of ultimate success Where experienced persons, backed with ample capital, enter upon the production of a staple article, the first object may reasonably be the purely capitalistic one of attaining the economies of production on a large scale. But where the establishment of a new enterprise involves the trying out of a number of experiments as to processes or selling plan, the initial scale of operations should be as small as will yield the desired experimental knowledge. Such a business should aim to be at first as purely as possible an enterprise selling personal service, until the experiments show that it is safe to use capital in it freely A strong element of uncertainty always means that investments of a permanent and specialized character, such as those for buildings, machinery, and manufactured stock, should be kept at the minimum, and that long-term contracts for materials, for the services of high-priced experts, or for the use of patent rights, should be avoided It is sometimes possible, in making a beginning in manufacturing, to contract for such parts or for such semi-manufactured materials as require expensive plant, or as involve in their production only ordinary converting profits

The small beginning has many advantages The proprietors are closely in touch with details. Results are quickly known. If there is success, the particular line of effort can be followed up promptly. If there is failure, a quick change will keep losses within small figures In a few months or years the proprietors will have put themselves through a training school They can

then expand their operations with a grasp and safety not otherwise attainable.

There is, however, to consider, as an offsetting circumstance, the size of the average successful plant in the industry, and the probability that the new establishment can compete, on fair terms, in economy of operations.

The scale will depend upon the type of industry proposed. A study based on census data, and supplemented by information specially gathered, thus classifies the industries which tend toward large-scale operation:

"1. Industries which require a large capital investment, particularly in plant and equipment: sugar refining, copper smelting, steel mills.

"2. Industries which are monopolies, and which have a sufficiently large market to make operation on a large scale feasible. This includes artificial monopolies, such as those based on patent rights, as well as the monopolies by nature: public utilities, the manufacture of ice, etc.

"3 Industries in which a natural resource is required, and in which that natural resource is limited in amount and localized in geographical distribution: the manufacture of lead and zinc products.

"4. Industries in which the product is capable of standardization, and particularly in which a test for quality is required: sugar, salt, meat packing, etc.

"5. Industries in which the product is highly complex and can be constructed, therefore, only by an intricate fabricating system, or a large and diversified organization typewriters, adding machines, textile machinery, and automobiles

"6. Industries in which the product is large in size, requiring complex equipment for construction and large capital investments. shipbuilding, locomotives, ordnance."

On the other hand are the industries which lend themselves to small-scale operation. These are classified as follows·

"1. Industries whose product cannot be standardized and establishments which attempt to make products to suit the differing tastes of consumers Such industries produce 'tailored' suits, high-grade furniture, art goods, finely bound books, etc.

"2. Industries producing for a small market, such as those

manufacturing artists' materials, nets and seines, models and patterns

"3. Industries in which the local market is small and whose product has a high transportation cost In the manufacture of artificial-stone products, or bricks in many localities, the activity could never be conducted on a large scale.

"4. Industries in which the material used is widely scattered and cannot be concentrated because of high transportation cost or rapid deterioration. Cheese factories and cider mills may be included in this class

"5. Industries in which skilled labor is the chief element, such as engraving, job printing, etc, whose products are really services rather than commodities"[1]

Partnerships.—It has been said, "When you are considering a partner, do not be in too great a hurry—give yourself time to test him Choosing a partner is like choosing a wife marry in haste and repent at leisure—in either case there is need for second thought and sure knowledge"

The partnership relation has many disadvantages for a business which is to use much fixed capital, or in which individual transactions may involve the creation of large liabilities The partnership does not create an artificial person, but merely establishes a limited set of relations between natural persons Each partner is an agent able to bind the others with respect to all regular matters, such as the buying and selling of stock in trade, the employing of servants and agents, the borrowing of money, or the issuing of negotiable paper, and the compromising or releasing of claims While the acts of a partnership are in the name of the firm, the responsibility created is individual, resting upon each of the partners, and usually unlimited, no agreements between the partners to limit this liability having validity as against the claims of outside uninformed parties When, therefore, one member of a partnership is negligent, or commits a tort, or is guilty of a fraud, within the scope of his authority, his partners are equally liable with him, financially In the conduct of the ordinary affairs of a partnership a majority of persons governs. while, in case of any

[1] The Integration of Industrial Operation, Willard L Thorp, Census Monographs III, Census Bureau, Department of Commerce, Washington, 1924, pp 88–89

important departure in policy, any dissenting member can oppose an effectual bar. No partner can compete with his firm, nor can he, without express permission, sell to it, or buy from it, or otherwise deal with it as an outsider, without rendering himself liable to the others for an accounting of profits. Interest in a partnership is not transferable without unanimous consent Unless there is an agreement to the contrary, the death or withdrawal of a member dissolves the partnership. A partner may even be held responsible for the acts of a firm after he has withdrawn from it if any third parties, not having received notice of his withdrawal, deal with the firm relying upon his continued liability.

The Corporation.—Most of the disadvantages of a partnership can be avoided by organizing an enterprise as a corporation. An industrial corporation is a collection of natural persons empowered by law to perform a designated range of industrial acts, and to enjoy the facility of operating as a unit or artificial person. The members of a corporation can contract, hold property, and sue and be sued in the corporate name. They may possess a common seal. They may frame by-laws for their own government. They have the power of continuous succession, during the prescribed period of corporate existence. In contrast with the partnership, a corporation has the advantages that it cannot be dissolved by the act of an individual member, that its members are not agents unless specially appointed, and that the liability of the shareholders is limited, as a rule, to the par value of the stock held by them; managerial control lies with a majority of the shares. The stocks and bonds of a corporation possess many advantages as investments for persons who do not desire to be active in management. For this reason a corporation has an advantage over a partnership in raising capital and in borrowing money.

The Corporation Charter.—The drafting of the charter of a corporation is an important matter, inasmuch as only such powers are possessed by a business as are expressly conferred, or as are implied in the realization of its avowed lawful objects or by reason of its existence as a corporation. An industrial corporation has, usually, the implied power to borrow money, to appoint agents, to issue negotiable paper and receive the same in payment of debts, to take and hold property in trust and execute the trust when conformable to expressed objects,

to purchase and dispose of its own stock, and to purchase and hold as much land as may be necessary to accomplish the purposes of its creation. It has not the power to lend money, except surplus funds, unless banking powers have been conferred. It has not the power to become surety for another, unless it be given the franchise of a surety company. Nor has it the implied power to take the stock of another corporation, except for debt or in payment for goods, and then only with the intention of selling it and not of holding it. A manufacturing corporation cannot engage in buying and selling goods, except as this may be necessary or incidental to its declared object. A corporation empowered to manufacture one kind of goods cannot manufacture other kinds. A trading corporation empowered to buy, sell, and hold certain kinds of goods cannot trade in other goods. Any action of a corporation beyond the scope of its authority is *ultra vires* and void. An injunction against such contemplated action may be secured by a dissenting shareholder.

In drafting a charter two rules of legal terminology should be held in mind (*a*) The express mention of a thing is tantamount to an exclusion of other related things (*b*) When a general term follows a special term it is held to apply only to the kind or class of thing which has been specially mentioned. Thus, a corporation authorized to carry on "a business of mechanical engineers and general contractors" was held only to have the power to do such acts of "general contractors" as it was usual for "mechanical engineers" to perform.

Local Capital.—New concerns of small size, known only near home, will usually be dependent upon local capital The local investor has a natural advantage in keeping track of his interest. This makes the local man of means the logical patron of new small enterprises. It is, as a general rule, easiest to raise money for a new establishment in those localities which have already before them the example of successful establishments in the same line As a rule, also, an individual will more easily make a new investment in a line of industry in which he has previously had success than in an untried line

Trustees.—When investors do not constitute a local group, able easily to keep in touch with the progress of launching, it is advisable that subscriptions to stock should be deposited with

a financially responsible trustee, such as a bank or trust company, which trustee is bound by the terms of a carefully drawn agreement. Such an agreement should provide that, if sufficient funds are not subscribed within a given period to make the undertaking possible, the money of subscribers shall be returned to them, less an agreed percentage allowed to cover the expenses of promotion. Upon receipt of sufficient funds, the trustee should be empowered to apply them for explicitly designated purposes, upon the presentation of vouchers drawn by the proper officers, and under a system of inspection calculated to insure the honest use of the funds for the intended purposes.

The Promoter.—If the leading individuals in an enterprise have not the time or the talents for the work of promotion, it may be desirable to employ a professional promoter. Promotion in recent years, in this country, has become a business in itself. A class of men has sprung up to serve as middlemen or intermediaries between men with money to invest, and men with undeveloped property or unutilized ability which is for sale. The less influential of these middlemen employ themselves chiefly with the functions of stock and bond salesmen, organizing campaigns to dispose of securities. The standard promoter, however, is an expert in assembling a proposition. This he does by securing options upon the necessary property, and by working out the plans of organization and operation far enough to reveal the significance of the project to the capitalists who are to be approached.

Syndicate Managers.—The highest class of promoters is composed of the representatives of syndicates of banks and groups of large private investors. These persons, after making rigid investigation, recommend the financing of the propositions they approve to the moneyed interests which depend upon their judgment. The financing which syndicate managers provide usually takes the form of the purchase of a block of securities of the newly organized corporation at special prices, care being taken to secure sufficient representation upon the board of directors. When the financed corporation has established a record of earnings so that the market may be trusted to take care of itself, or when the period within which it was undertaken to control the market has expired, the syndicate members may dispose of their securities, making such profit as they can above the purchase price.

Engineering Promoters.—There are in existence a number of promoting corporations which have, in addition to the usual financial machinery, a corps of engineers able to take charge of construction, and a corps of administrators able to supervise going businesses. These promoting engineers are able to pass upon propositions the analysis of which demands engineering skill. Upon accepting a project they construct the works and receive their pay in securities. They then either sever connections by selling the securities, or continue in the control of the management as the representatives of investors affiliated with them. Engineering promotion of this character is now important in the building and operation of irrigation works, street railways, waterworks, gas-works, and plants furnishing electric light and power.

Application of Funds.—The funds in the hands of a new business must be allotted in such a way as to cover various classes of requirements. A portion will go into fixed and relatively permanent forms, such as buildings, machinery, and office equipments; another part must be reserved for raw materials, finished stock, pay roll, credit advances to customers, and other rapidly changing forms of investment. This classification brings into view the contrast between fixed and circulating capital, with regard to which the following points should be noted.

1. Circulating capital is that which encounters frequent liquidation, or change in the character of the property which represents the values. The opportunity of changing the form of investment frequently occurs. Fixed capital requires considerable periods of time for the wearing out of the property and the gradual release of the values for reinvestment. As the values disappear from the original fixed forms they find existence, in transmuted form, in the increase of the values of the materials worked upon. Liberal fixation of capital is appropriate only for enterprises of a permanent nature.

2. Fixed capital may be of various degrees of specialization. Specialization may be of form (only useful for certain purposes) or of place (only available for enterprises which can accept the location). When a factory is built in a thriving city, and is of standard loft design and arrangement, so that it can be turned to a variety of manufacturing uses, a considerable portion of the values locked up may be recovered by sale, if the original project

fails. If, however, a plant is located in the country, and is strictly specialized for one purpose, if that use fails, the loss is heavy. The degree to which capital should be specialized is a function of confidence in the soundness of the nature of the project and of its location.

3. The recovery of the values in fixed capital is a process requiring the continuous supplying of circulating capital. Materials, labor, and repairs must be provided to support the productive process; and without them the values locked up in fixed forms will be wasted. Mr. James Hartness has said, "A plant and business is useless when not in motion, and when under headway requires money. Money must be poured into it steadily to an amount which, every year, generally equals the total capital in the business. Much time and energy have been consumed in careful consideration of the cost of the plant, but not enough thought has been given to the money tied up in the business in other ways."[1] In short, as Poor Richard said, "It is easier to build two chimneys than maintain one in fuel."

4. To a limited extent there is a reciprocal relation between the amounts of fixed and of circulating capital required to carry on a productive process. A factory building of concrete has a lower insurance and maintenance charge than a frame building. With sufficient mass of traffic, a well-built railroad will attain lower ton-mile costs than a cheaply built one. The normal balance between fixed and circulating capital is reached when the saving in operating expenses to be effected by the next increment of fixed capital is equal to the fixed charge which that increment will create.

5. There is danger in the launching finance of underestimating a certain class of necessary expenditures which result in the intangible forms of capital bearing the names "good will" and "going value." Among such expenditures are the costs of organization, of introducing a new product to the trade, of maintaining a state of productive efficiency during the initial period of waiting, and of learning many kinds of wisdom by experience

In the launching of an enterprise there is a difficulty in determining what valuation to put upon intangible properties such as patents, trademarks, good will, going value, and the services of

[1] Human Factor in Works Management, N. Y., 1912, pp. 133-134

organizing officials, promoters, and various persons supposed to have knowledge or influence. Consequently, there is the danger that the newly assembled business may start with a capitalization out of proportion to the earnings it can make.

The expenses of establishing a new business (unless put through in the simplest possible manner with much unpaid labor on the part of the promoters) are greater than would be anticipated. Many fees and traveling allowances for business, engineering, and legal experts will have to be met. There may be an expensive canvass to sell securities and there is sure to be one to secure initial orders Meanwhile, the salaries and rent and office expenses, necessary to keep the organization going until production begins, must be met

This may be illustrated by the items of expense incurred in starting a gas plant business, as they have been enumerated by C W Gerstenberg

1 Preliminary development, which includes
   (a) Investigation of the project
   (b) Assembling of parties who may be willing to participate
   (c) Preliminary engineering and legal advice on the proposition.
   (d) Canvass of territory to ascertain if sufficient business can be obtained
   (e) Estimate of cost of plant and probable income.
   (f) Incorporation of the company
   (g) Securing the franchise
2 Real estate
3 Labor, materials and sub-contracts
4 General contractor's profit
5 Engineering
6 Expense of company organization during construction
7 Interest during construction
8 Taxes and insurance during construction
9 Stores, supplies and working capital
10 Acquiring or establishing the business
   (a) Expenses of canvassing for business
   (b) Advertising
   (c) Setting meters free of charge
   (d) Interest on cost of plant in excess of income until business becomes self-supporting
   (e) Taxes and insurance during that time

11. Legal expenses.
12. Financing, including banker's commission, discount on bonds, and promoter's profits [1]

While many men of ability have gotten their start on borrowed capital, the borrowed capital in a corporation is likely to become an exacting element. Borrowed money entails the obligation to pay definite sums at definite times, or permit the affairs of the business to pass into the hands of the courts, with the instant destruction of intangible values, and the partial destruction of all other values. As a new business is uncertain as to the sums and times of its earnings, it is safe in proportion as the borrowed capital represented in it is less.

The young business, especially, should practice every precaution of finance; buying sparingly on long credit, selling on short time, collecting promptly, carrying minimum stocks, paying moderate salaries and small dividends—or none at all,—thus protecting working capital in every way, and striving to build up a surplus

There is an art in handling funds, as there is an art in handling people, or in managing the physical equipment of production. In this art a knowledge of vital facts and the ability to plan ahead are as essential as in any other art. An enterprise should not use more money than is needed; for idle money depreciates at a rate equal to the rate of interest. Nor should there be less funds than are needed; for this means to miss business opportunity. Definite obligations falling due in the future must be built up to by the timely accumulation of funds through a process as congenial to the normal functioning of the business as possible. A definite release of funds in the future, from present use, in like manner, must be prepared for, by the development of plans which will promptly put the power of capital at full work again. Funds can be likened to a corps of workmen on the payroll. Their wage is interest. Like workmen, the funds require management, a steady program of work—neither overwork nor soldiering—must be laid out for them.

Voting Control.—In the early financing of a business the

[1] Materials of Corporation Finance, C W Gerstenberg, N Y, 1915, pp. 455–456 Summarized in Business Administration, L. C. Marshall, Chicago. 1921. pp 389–390

question of control is constantly involved In the day of small things a few hundred dollars may decide where control shall rest and, if growth is later made from undivided earnings, and if successive issues of stock are made proportionate to holdings, such early investments may decide in whose hands large ultimate values shall rest. By the use of preferred stock to represent money and property contributed, and common stock to represent services, patent rights, etc., and by the limitation of voting rights to the common stock, except under certain specified conditions, such as the passing of a preferred stock dividend, it is possible to adjust voting control in any desired manner among a group of persons. In practice, voting power is highly concentrated in American corporations, by the use of proxies A more permanent concentration of control can be effected by the transfer of stock, for a period, to voting trustees At any time an option to purchase stock at an agreed price can be given to parties who desire to increase their control, and during the life of such an option the stock may be held in escrow.

Time of Flotation.—Mr. Herbert Hoover has said, "Our studies of industries as a whole show that we usually expand our equipment at the periods of maximum demand for their products instead of doing our plant extension during periods of slack consumption. We thus make double demands on labor and we doubly increase unemployment in periods of reduced consumption"[1]

The business of the country passes through a succession of trade cycles of uncertain duration, varying from 30 to 50 months or more in length. The periods of trade activity, or general business prosperity, are reasonably well heralded in advance by the conditions of the money market and the stock market. And they proceed in a logical way, by first involving the more basic lines of manufacturing, and subsequently spreading to industries dealing with complex products and consumer's goods

The order of changes in a cycle may be indicated approximately as follows

1 Money is plentiful and interest rates are low
2 Gilt-edged securities rise
3 Speculative securities rise

[1] Mechanical Engineering, March, 1921, p 219

4. Commodities of short life rise in price Business prosperity.
5. Commodities of long life, such as real estate, the value of which is partly a forecast of future earning power, rise
6. Money becomes scarce and interest rates are high
7. Gilt-edged securities fall
8. Speculative securities fall Crisis followed by depression.
9. Commodities of short life fall
10 Commodities of long life fall.
11. Money is again plentiful and interest rates are low

Considering the trade cycle, it has been suggested that the financing of new enterprises, or of extensions of old ones, may be most advantageously carried out during periods 3 and 4, while securities are still being absorbed freely at high prices, and before a panic breaks The money so raised can then be applied in providing equipment during the ensuing depression, while the prices of materials and labor are low. The aim of a launching plan thus timed would be to prepare for business slowly and thoroughly, to try out processes, select the cream of the labor market, establish discipline, and settle all factors into a smooth working order, so as to be ready to take advantage of the first recovery in demand.

Mr. Matheson has said: "if (an establishment) is transferred at a time of high prices, the real value depends mainly on the readiness of the factory. If, because of high prices, capitalists begin to build new works, it will often be found that by the time they are ready prices have fallen, probably because new factories have increased the productive power, or even because the mere prospect of new factories induces competitors to lower their demands. It is in a time of deep depression that prudent purchasers will often find the best opportunity for buying or building a factory."[1]

A subscription to any one of the leading financial services will provide frequent bulletins as to the buying power of agricultural districts, the freedom with which goods are moving at wholesale and retail, the amount of outstanding loans of the Federal Reserve banks, the number of commercial failures, the activity of the building trade, the production of coal, iron, and other staples, the prices of these staples, prices of representative groups of bonds and shares, and many other kinds of barometric data.

[1] The Depreciation of Factories, 3d Ed., London, 1903, pp. 111 115.

The method of financing should be adjusted to the stage of the trade cycle In the beginning of an optimistic expansion bonds may be offered to good advantage. At a later time, when speculative enthusiasm is strong, stocks will yield better returns. During depressions short-term notes may be issued, if the credit of the issuing corporation is high The financing plan may be adjusted to the conditions of the money market and the security market by varying the proportion, rate of yield, term, denomination, and guaranteed rights of the securities issued.

Processes.—A preliminary study of the steps of manufacture should be made with the utmost thoroughness. If new processes are to be introduced, it must be determined whether the apparatus deserves patenting, or whether any feature is to be preserved as a trade secret. In this connection a word of warning may be dropped. Successful processes or mechanisms are usually a matter of slow growth. A new mechanical contrivance, which is to be offered to the public as a consumer's good, is usually in a crude state when patented, it is almost never brought to perfection until the designer's original idea has been thoroughly revised in the light of shop experience in production and consumer's experience in utilization Furthermore, an American patent, covering an idea of real value, has been defined by those who have had experience as a "license to litigate"

Buildings and Equipment.—It is only on the basis of the exact determination of the nature and sequence of manufacturing processes that the character of the buildings, machinery, yard spaces, track connections, and general layout of an establishment can be specified and contracted for There are two difficulties with reference to equipment which lie in wait for a new concern The first is that articles must be bought by persons who are more or less inexperienced, and of whose ignorance certain supply dealers are willing to take advantage The second is that the new equipment must be tried out by a force not yet seasoned to its duties nor accustomed to working together The probable result will be low speeds, heavy wear and tear, considerable spoiled work, and numerous accidents

Second-hand Plant.—The advice of men of experience is against the purchase of second-hand plant or machinery The

record of a failed concern casts an unpleasant shadow upon a new tenant. An establishment of old design, built with a different original purpose in mind, imposes many limitations of arrangement, lighting, heating, ventilation, fire hazard, and power supply. The exact state of old equipment is hard to judge, not only with reference to physical condition, but as to how obsolete it is in comparison with new models. The buyer of new machinery can rely upon coming fairly abreast of the evolution of machine design. With such purchases comes the maker's original guarantee. By patronizing firms of established probity and technical efficiency, much help will be received in the way of expert advice as to the best models to select for the purpose in hand, and in the form of preliminary instruction in the methods of operation.

Managerial Staff.—It goes without saying that, as the general scheme of functions of a mechanical, mercantile, and financial nature is conceived, steps should be taken to define clearly the various classes of executive duties, and to group them in such a way that there will be arranged for each person a consistent range of functions, and that these persons will be bound together in a well-balanced administrative hierarchy. It is an advantage to record the administrative determinations on a chart of authority, as they are made, to insure that every necessary duty has been assigned, but that no one is overloaded. Unless a beginning is made with clear-cut decisions and adequate records, a confused temporizing habit of muddling along will be established, which will be difficult to break, not only because of the subtlety of the repressed attitudes, but because of the sensibilities which must be regarded in carrying through anything which has the appearance of a "shake-up."

The Labor Force.—A new business, having no men of its own training, must face the problem of gathering rapidly a complement of skilled workmen and capable foremen. Men who come together from various shops, bringing with them different ideas as to speed and method of work, as to the etiquette of foremanizing, and as to shop rules generally, have to be brought into harmony with strange policies and become adjusted to an inexperienced staff of superior officers. A new management tends to fall heir to the riff-raff of the labor market, which is

ever moving on to the new employer for reasons best known to the old.

The Addition of New Functions.—The enlarging of a business undertaking, especially if it be the taking on of a distinct line of manufacturing or trading operations, should not be merely drifted into, but should be given thought, and entered upon as deliberately as was the launching of the parent enterprise. There are few rules that can be offered, further than to avoid the weakness of scattering efforts. Conservatism would counsel one to follow the line marked out by past successes. "He that enlargeth his dominions," said Sir Walter Raleigh, "doth not always increase his power."[1]

The markets of the present day, upon which the manufacturer buys talent, money, and equipment, and upon which he sells products, are so completely equipped, and there is in addition such a variety of service industries at hand to aid him, that the administration of diverse activities and separate plants is easier than it ever has been before. As a result, there has been a movement for many years to integrate industrial operations under the control of central office managements. There are a number of circumstances which have led present organizations to branch out. A management which is contemplating a new project may do well, therefore, to examine its situation, to see whether any of these favoring circumstances are present in its case.

Some enlargements have been to invest funds which have accumulated. Others have been to divide risks, by providing several more or less distinct lines. An important object has been to manufacture some article which can be sold along with the present product as a part of a complete trade assortment and which can be handled by the present sales agencies and traveling representatives with little additional expense, and the achievement of greater sales density. One motive has been to regularize operations, both for the plant and for the sales force, by taking up a line which indents in demand with the present product, and so will give work during the dull season. In other cases there has been equipment or technical staff, not used to its capacity because of the limitation of the market, and which can be more fully utilized by adding an analogous line. Such a case is that of a bakery

[1] The Cabinet-Council, Sir Walter Raleigh.

baking cake as well as bread, a canning factory preserving fruit as well as vegetables, or a flour and feed mill handling corn as well as wheat. In many cases, the extension of activities has been to create a larger demand so as to make possible the purchase of raw materials on a larger scale, or at less cost, or to secure more consideration of the company's special requirements from suppliers. Or, the project may advance a step further, to the control of raw materials from their sources, so as to be able to eliminate a market with its expense and uncertainty, secure the supply at cost, have it available when wanted, and be able to dictate the grade desired. Occasionally, an extension has been to produce a by-product from a waste, or to manufacture some supply, or to do the company's own repairing.

Problems

The Market for Funds.—It has been said, "Money or the use of money—is bought and sold like flour and cutlery Money service is not always the same either in quality or in price Money markets vary Credit—which is the assurance of repayment you give means different things in different markets Financing a business means expertness in buying, in selling, in using funds. Men who finance store and factory with success first know their own condition exactly; then check over those who sell funds and apply to such sources as offer precisely what they need They go to the best money market with carefully prepared purchasing power and buy with expert foresight precisely those funds in amount and in terms which the business needs." Make a list of the different kinds of security a manufacturing business can offer, and a second list of the sources from which funds can be secured. Indicate which type of financing proposition—defined as to security, term, and amount - should be presented to each supplier, and give reasons. Consult W. H. Lough, Corporation Finance, N. Y, 1916, pp 122–132, and general references on corporation finance, credit, banking, investment banking, etc.

The Financial Structure.—Examine the balance sheets of a number of manufacturing corporations (avoiding consolidated balance sheets and inexplicit statements), as given in Moody's Manual of Industrial Securities, and draw off a tabulation of the amounts of different kinds of securities, such as bonds, stocks,—preferred and common,- notes, debentures, open accounts, etc, which represent claims to the assets Classify these financial structures into types, as the figures may suggest, and deduce typical percentages

The Basis of Confidence.—"The first problem in financing a business is to get the capital Wherever you may look, your chances to secure

money depend solely upon the confidence that you can inspire It is confidence that determines the banker to grant you a loan, confidence that influences the supply house credit man to extend you a line of credit, confidence that attracts the partner and makes possible the stock issue, confidence that secures you loans from private investors " Upon what bases does credit rest, and what, therefore, are the tests of the vitality in a proposition to launch or to enlarge a business?

Bank Financing.—George M Reynolds has said, "Banks base credit on the assurance that borrowers can pay out of their quick assets " On the basis of interviews with a number of local bankers, compile a statement of the exact proper function, in the financing of a manufacturing concern of moderate size, which it is the province of the local bank to undertake Distinguish this financing function as carefully as possible from the financing of suppliers of materials, equipment, etc

The Safeguarding of a Bond Issue.—Draw up a statement of some of the chief safeguards which are introduced into the recitals of mortgages which underlie modern issues of corporation bonds If the material for it can be secured, give special attention to the bonds of manufacturing corporations Secure from individual investment bankers bond circulars and reprints of mortgages Also, examine the literature issued by the Investment Banker's Association of America, 111 West Monroe St, Chicago See also Lawrence Chamberlain, The Principles of Bond Investment, N Y, 1911, Holt, and Andrew Squire, "Essential Recitals in the Various Kinds of Bonds," Annals, 1917 Vol 30, pp 248–256.

The Discovery and Assembling of a Proposition.—What activities are involved in the discovery and assembling of a proposition for the inaugurating of a manufacturing enterprise, up to the time the capital interests —syndicate or other—take control? Reference W H Lough, Corporation Finance, N Y, 1916, E S Meade, Corporation Finance, N Y., 1910, etc

Launching Finance of a Machine-Tool Business.—A company of men have united to launch a machine-tool business of moderate size It is estimated that it will require two years before income from operations will be sufficient to carry the enterprise The promoters have contributed funds and bought an admirable piece of real estate, upon which are several buildings which, with some reconstruction, can be utilized New buildings will be required, however For the funds so advanced the promoters have taken common stock It will be necessary to raise $500,000 at once, and an equal amount a year hence, and two years hence This money it is planned to secure by the sale of bonds at $95 (par $100) The bonds will bear interest at 5 per cent per annum payable semiannually Taxes must be paid one year hence and two years hence on 50 per cent of the true value of the property (calculated at $1,500,000 a

year hence and $2,000,000 two years hence) The local tax rate is 2 per cent. Insurance must be taken out upon the structures, $100,000 at once, for the buildings already on the property, $200,000 additional a year hence, and $750,000 additional ($1,050,000 in all) two years hence. The insurance premiums will be $\frac{1}{2}$ of 1 per cent. The remainder of the funds, not provided for otherwise, is to be raised now by the sale of an issue of preferred stock. This issue is to be taken at $90 per share (par $100) in agreed proportions by the group of men chiefly interested, no dividends (which will be at the rate of 6 per cent) to be paid until the third year Bank balances on the cash received from the sale of stock will draw interest at 4 per cent per annum on minimum balances, payable semi-annually The bank interest allowed on bond money is to be put into a petty cash fund, to meet unexpected items, and need not be calculated. It is desired to ascertain what amount (par) of preferred stock must now be issued to provide the funds necessary to carry the enterprise through to completion as a going business In arriving at the required figure all interest and discount calculations must be carefully considered. Brief tables of compound interest, compound discount, annuity, and present worth will be found following the problems of the last chapter (Chapter 29) of this book.

NOTE: By changing the terms of this problem, within the limits permitted by the interest tables, the instructor may construct as many problems of this order as he may require.

The Proper Size of a Proposed Cement Plant.—A group of capitalists, proposing to establish a plant for the production of Portland cement, estimate that the market open to them will absorb 200,000 barrels per annum at a price of $4.00 per barrel, 500,000 barrels at $3 50, and 800,000 barrels at $3.00. Their preliminary cost estimates indicate that a 200,000 barrel plant will require a capital of $4,000,000 and will produce cement at a cost of $2.20 per barrel. A 500,000 barrel plant will require $7,000,000 of capital, and will produce at a cost of $1.80 per barrel. An 800,000 barrel plant will require $11,600,000, and will produce at a cost of $1.60 per barrel. Which scale of operations will yield the highest rate of profit on the capital invested?

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CHAPTER III

LOCATION OF AN ESTABLISHMENT

Location determines, to some extent, the efficiency of every economic factor. Much progress has, undoubtedly, been made in a generation in evening up local inequalities, and so in reducing the significance of the factor of location, by the standardization of machinery and factory buildings, the leveling of wage rates and interest rates, the wide distribution of technical information by the trade press, the more uniform operation of the agencies of education, and by the standardization of habits of consumption over wide areas. But locality still exerts a decisive influence on the accessibility of raw materials, convenience to markets, and the degree of rivalry and emulation under which men work.

The smaller an establishment the more significant is the question of location to it. A small establishment has chiefly a local market, and appeals only to nearby investors. It is compelled also to employ outside service industries to perform a wide range of functions for it, and so flourishes or suffers according to the completeness or incompleteness of the local equipment. A large concern, on the other hand, can be more self-contained, because it will support its own service departments Such a concern, being more widely known, can look farther afield for capital and managerial talent. Its mass of capital and its extensive personnel enable it to exert a transforming influence upon its neighborhood. Whatever the significance of location may be, in any individual case, that influence is made well-nigh irrevocable, when once determined, by the difficulty of moving.

Nearness to Materials.—There are a variety of factors entering into material cost. Besides the obvious matters of original purchase price, buying expense, and transportation rate, there are such items as the expense of the reserve stock which must be carried at the plant to allow for irregularity of supply, and the extra con-

verting expense caused by lack in range or dependability of quality The effect of reliability of supply and of a wide assortment from which to select is frequently so great that an establishment will prosper better in a great market than in a region of original supply The usual conception that the cotton mills of the South use the cotton grown in nearby fields is largely an illusion. When the machinery of a spinning mill has been adjusted to a certain length of staple, and customers expect a uniform quality of yarn, it is necessary to purchase certain grades of cotton only, and to do so on a market in which grading is accurately done. In such a market the price will be regulated by the New York price, and from such a market to the southern mill the freight charges will be high local rates.

The ideal location with reference to materials is the one where all factors combine to make the lowest possible raw-material cost per unit of completed product. The test is not the cost of a unit of materials laid down, but the material cost of a unit of completed product. In the latter figure the relative importance of the different materials involved in the product is brought to a final balance. The location of perishable or bulky materials will, of course, exercise a special effect upon material costs.

Beyond the effect of location upon the supply of such materials as are specifically required by an industry as its raw materials, there is the broader effect resulting from the presence or absence in the neighborhood of those natural resources which are requisite for the well-being of a body of people. The cost of a raw material depends not only upon the crude resource which is to be directly exploited, but upon the local cost of labor, capital, and management. The cost of these factors will in turn depend upon whether there is an abundance or scarcity of the things required to maintain a satisfactory standard of life It is said that there are many rich ore deposits known in the West which are unexploitable because of inaccessibility This inaccessibility really means that those ores are in a region bare of the resources required to support life

The difficulty lies not so much in getting the ore out as in getting supplies in to the workers If a raw material lies in a region where timber is scarce, so that wood must be brought a long distance for houses, if there is no coal nearby, so that power is expen-

sive; if there is lack of water, so that agriculture is impossible, and the food of men and horses must be brought in by train and pack trail, if, in short, the material which is the object of calculation is unassociated with the other materials upon which industry depends, it will need to possess extraordinary quality and quantity to develop any value, for the high costs will fix the margin of exploitability at a high point. The value of any resource or raw material in a given location is partly the reflected image of the general fitness of that region for life, industrial effort, and civilization generally.

The great resources which make most regions prosperous are a fertile soil and a suitable climate to provide cheap food, good steam coal or water power to give low-priced power, and adequate structural materials to make the cost of housing moderate

Nearness to Sources of Power.- In so far as power is transformed coal, oil, or gas, the advantage of location with reference to these materials will imply advantage with reference to power. Location close to water power will be attractive for continuous-process industries, like flour milling or paper manufacture, and for industries, like pulp mills, which must locate in remote districts where transportation rates on coal are high. The advantage of locating where public service industries furnish electric power consists not so much in the price per horse-power year, as in the fact that capital does not need to be invested in power plant, and that with a fluctuating load the expense for power rises and falls more closely in conformity with the amount used than is the case when a private power plant is maintained.

The increasing use of electric power in manufacturing makes it apparent that the geography of electric power production and transmission will increase rapidly in importance. The super-power map of New England and the North Atlantic states brings into prominence the power-producing regions, the leading of which are: the Niagara Falls, the falls of the St. Lawrence river, the upper waters of the Hudson river, the upper waters of the Delaware river, the Connecticut river, the coal regions of eastern Pennsylvania (especially such localities as Pittston, south of Scranton, Nescopeck, southwest of Wilkes-Barre, and Sunbury west of Hazleton), and such of the Atlantic ports as can discharge coal at low cost.

Between these regions and the consuming cities and bodies of industrial population, there will develop a super-power transmission system somewhat as follows:

From the St Lawrence river to Utica, N Y, and Northampton, Mass,
From Niagara Falls to Utica, N Y;
From Northampton to Worcester, Boston and Eastern Massachusetts, supplemented by power from the ports,
From Northampton south to Hartford, New Haven, and New York City, supplemented by power from the Connecticut river and the Sound ports,
From Utica to Schenectady, Albany, Hudson river points south, and New York City, supplemented by power from the upper Hudson river,
From Utica to Northern New Jersey centers and New York City, supplemented by power from the upper Delaware river,
From Eastern Pennsylvania coal regions to New Jersey points, Philadelphia, Baltimore, and Washington, supplemented by power from the Susquehanna and Potomac rivers,
All of which will be knit together by a cross-network of lines connecting the important producing and consuming centers of the region

Labor Supply.—The supply of unskilled labor in a district is a tolerably simple function of the mass of total population. Difficulty in recruiting a labor force centers upon the higher ranks of craftsmen and the lower ranks of clerical and administrative staff Our chief dependence for skilled laborers is still immigration. The cities of the eastern seaboard, and the cities of the North Central states which are located on the Great Lakes, have an advantage in first choice from the incoming human stream This advantage has served, until recently, to congest manufacturing unduly in the northeastern section of the country. As between cities of similar geographical position and attractiveness as labor markets, the distribution of foreign-born artisans depends upon the accident of the formation of a colony of persons of the same race, language, and nationality, and possessing a size sufficient to satisfy social instincts Manufacturers of Minneapolis and Seattle depend upon their large colonies of Swedes and Norwegians Akron has its Austrians and Hungarians. The Poles are strongly centered in Detroit and Milwaukee and Toledo. New

Bedford, Fall River, and Oakland, Cal., have many Portuguese; while the Armenians are an appreciable resource in Providence and Worcester.

The reliance of the future for skilled labor must be increasingly upon specially adapted educational institutions American employers have not yet generally perceived the profit of local trade schools, as have the Germans. There seems to be a fear that a community which supports a special type of school will find itself paying for the education of young men of other neighborhoods. But a trade school is a device for skimming the cream of the youthful talent of the surrounding region and putting it at the disposal of the employers nearest at hand. The local employer enjoys the opportunity of making first choice from the exceptionally capable youths who have had the enterprise to leave home in search of an education

As between city and village, in the matter of labor supply, it may be said that the large center presents the advantage of the more highly skilled labor, and of the larger supply of floating labor available for temporary requirements by simply hanging out the card "Help Wanted." The small place offers a more steady and devoted force, and one the members of which are better acquainted with each other, and so more disposed to team work. Village labor is of good general intelligence, and not easily influenced by agitators who plan industrial disputes. And this supply the village offers at lower wages, corresponding to the lower costs of living.

The South still ranks as a reservoir of cheap labor, corresponding to a lower standard of living. But the advantage in nominal wages there is partly offset by less skill and less energy Then, too, the South is rapidly modernizing and improving its standards of living.

Capital.—There is an economic geography of the supply of loanable capital, and of the activity of financial institutions, as there is of raw material or labor supply. Every one knows that, in a general way, a loan or investment transaction which in the East would pass at 5 per cent, would require 6 per cent in the Middle West, and 7 per cent in the Rocky Mountain and Pacific states. More important to an individual business concern than the general level of rates throughout the country is the fact that

in small money centers the banks and investors are prepared for small transactions only, dealing in money at retail, while in large centers money is dealt in at wholesale. Retail prices are higher than wholesale. It is desirable, therefore, that an industrial institution should carry its financing to the largest financial market upon which it can establish a standing. In behalf of the bankers in small places it may be said that they have a greater sense of individual responsibility to take care of local enterprises than have the banks of the larger centers.

Association with Other Industries.—Competition between business establishments has been so much emphasized, and this competition has been so often looked upon as if it were a state of pure antagonism, that the truth has often been overlooked that industries usually thrive best in groups.

1. A number of similar concerns in a locality can usually secure materials to better advantage than any one can do singly. An illustration is the Chicago Union Stock Yards, supported by a number of packers, and able to absorb train loads of cattle without breaking the price This steadiness of price or "depth," which one firm alone could not insure, is what gives confidence to cattle men and promotes liberal shipments.

The concentration of a number of similar establishments serves to increase the variety of materials which can be offered by suppliers This may be illustrated by a textile weaving center such as Philadelphia. Because the spinning mills located in all parts of the East and South have selling agents there, manufacturers who desire to make mixed fabrics or specialty cloths find that neighborhood a good one to locate in, because they can there secure yarn of any material, size, color, and tightness of twist, at a moment's notice.

2. Concentration of establishments, even of a like kind and direct competitors, improves the labor market, both for employer and employee, in many ways. The city of Grand Rapids, Mich , has become a veritable training school for cabinet makers and furniture designers and salesmen. Even the public library of Grand Rapids has specialized, for it contains one of the best collections of books on furniture in existence. East Liverpool, Ohio, has become an objective point for English potters. The potters who are on this side keep up the supply by writing back

to their friends in "the five towns," telling them where to migrate. A locality preeminent in any line draws to itself such skilled workmen as lose their positions elsewhere and are averse to changing crafts, as well as such specialists as feel safer in a locality where there is more than one possible employer.

If the labor market of a large center becomes unbalanced, an attraction is created for establishments able to utilize the superabundant labor element. Thus, the silk throwing industry moved from New Jersey to the coal mining regions of eastern Pennsylvania to utilize the labor of the wives and daughters of the miners. A thermos bottle plant recently located in Huntington, West Virginia, partly because the railway car shops and other industries of that city provided little opportunity for the women.

3. In specialized centers the banks become familiar with the requirements of the dominant industry They learn the standing of the firms in the trade, and can more readily and safely discount the special line of commercial paper. And, if their resources become overtaxed, the recognition of their expertness by banks elsewhere makes it easy for them to rediscount.

4. A group of plants can jointly produce such a demand as will cause a variety of repair plants and supply houses and industrial service industries to establish themselves near by, such as foundries, machine shops, patternmakers, tool makers, mill supply houses, commercial laboratories, mill architects and designers, efficiency engineers, certified public accountants, corporation lawyers, etc. And in such a city there will be a choice of office buildings and standard manufacturing lofts.

5. Carrying the division of labor a step further, a specialized industrial center adds to the service industries various part makers and assemblers who, by concentrating upon special kinds of work, reach a high perfection. The presence of these concerns makes it possible for a new enterprise to confine itself at will to a restricted field, corresponding to its capital or technical ability.

6. Finally, a group of similar or related manufacturers established in one place serves to perfect their local market The reputation of each firm supplements that of others, until the name of the town becomes almost a trade mark, and a firm enjoys prestige from the mere fact of location in the noted place. South Bend

suggests wagons, Troy stands for collars and cuffs, Holyoke, Mass, signifies water power equipment, Grand Rapids means furniture, Detroit automobiles, Meriden silver plate, Providence jewelry, Milwaukee leather, and Paterson silk. To such markets consumers, dealers, and would-be agents are attracted, and the general rule that the seller must seek the buyer is, to some degree, reversed. This is well illustrated by the furniture expositions, held twice a year, at Grand Rapids, Mich, Jamestown, N. Y, and High Point, N. C

A large specialized manufacturing center is able to afford various commercial service industries such as packers, insurers, forwarders, professional graders and appraisers, commercial photographers and printers, advertising agencies, public warehouses, and trade papers.

In such a center, also, there will be clubs for executives, and a variety of semi-educational and inspirational activities Out of the intimate contact of leaders with one another there will result emulation, strict standards for judging competency, and a high degree of intellectual activity

The momentum of a great center is so great that it prevents other localities from lightly entering the ranks against it "In 1903, when the automobile business was any city's business, Schenectady, N. Y., would have been an ideal location from which to supply New York and New England through the coming years In 1921, though Schenectady had developed enormously in an industrial way, her opportunity in the automotive field was gone forever Michigan produced more than 90 per cent of our motor cars that year, while New York produced less than 1 per cent The automobile business had become Detroit's business A city is the right place to manufacture in only at the right time—and it is never the right time after another city has swept the field The fact that St Louis is the great shoe-city of the country does not prove that Kansas City, with similar transportation situation, climate and relation to rural America, would make a good shoe center. it proves that Kansas City wouldn't The place is right, the time has gone by" [1]

Separation from Other Manufactures.—There are also centripetal forces operating in industry, and a study of the distribution

[1] Paul W Brown in The Executive's Magazine, St Louis, March, 1923.

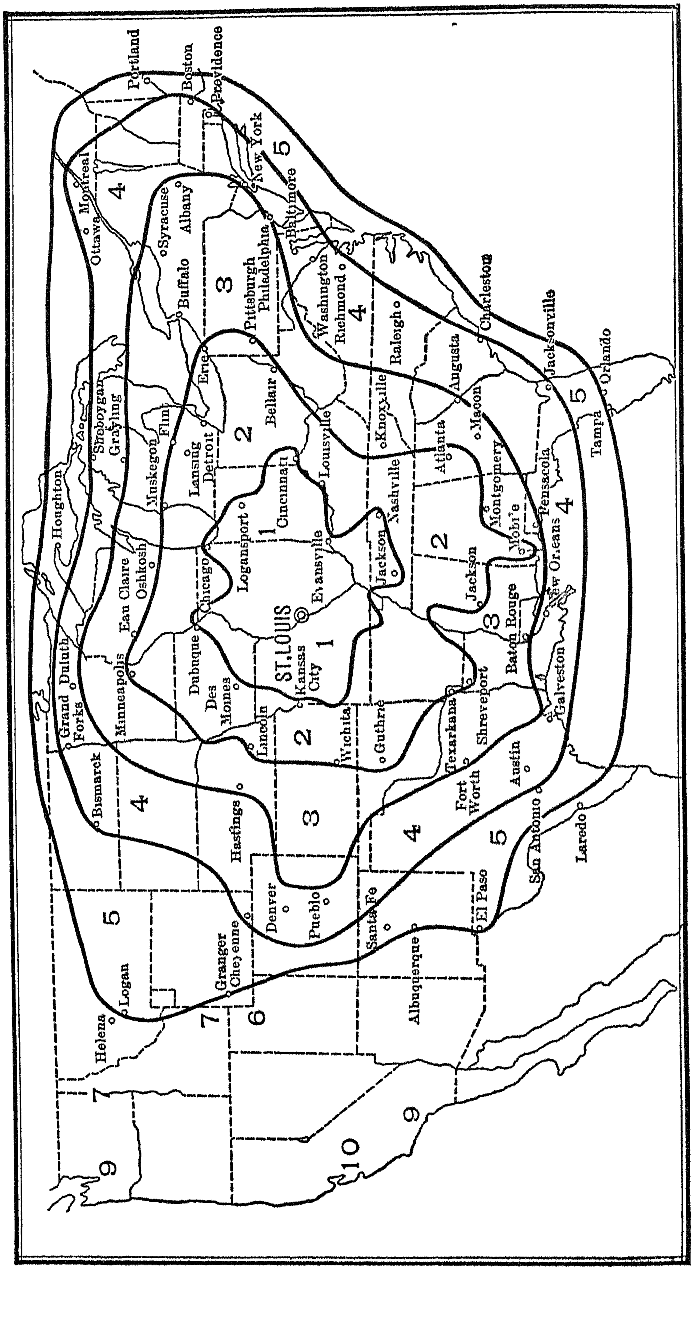

FIG. 1 —DISTANCE IN TERMS OF TIME.

The map shows the regions within which package car freight, despatched from St Louis, will arrive at destination, in the indicated number of days

of plants will show that many are outside of any great manufacturing center, or even any specialized district

Some isolated plants will locate upon or near to raw materials. Many others will scatter wherever consumers are to be found, so that it may be said that the principle of their distribution is that of the distribution of the general population In the latter class are those which manufacture a bulky, perishable, or timely product widely consumed, such as brick or ice cream or the local newspaper; those which make a product to order, such as clothing, either on direct order, or on orders received through local retailers; and those which carry on a repair industry, like shoe repairing, which serves consumers directly. A third and somewhat different group of industries will find their markets in any small city where there are a number of stores and offices, because they build or adapt equipment and supplies, such as blank books, printed forms, rubber stamps, and cabinet work, for them. A fourth group is a function of building operations, such as the local planing mill which manufactures doors and sash and trim. A fifth group of establishments is composed of those which are functionally quite independent of outside influences, so that they have sprung up wherever a dominating personality has appeared. Such are industries which employ a simple hand or shop process, like that used in the manufacturing of tobacco; those which can secure with one or two machines most of the mechanical advantages attainable, like cutlery manufacture; those which compound some standard chemical or pharmaceutical ingredients by a simple process into products capable of being protected by trade marks, such as the manufacture of patent medicines, perfumery, and cosmetics.

There are also manufactures which produce an article which is not strongly tied into any trade assortment, such as flags and fireworks. And there are establishments which supply demands of too subordinate a character to permit of operations on a large scale. To these various classes of scattered manufactures are now coming others, which are migrating outward from the cities, to escape the burden of municipal taxation, to secure adequate factory grounds, to permit one story or low factory buildings instead of multi-storied city lofts, to secure adequate housing for employees, and to escape labor restrictions and hostility by settling in

neighborhoods small enough so that management and men can have more natural contacts, and can perfect a better understanding.

The foregoing discussion should be considered in connection with the analogous one of the scale of operations, presented in the preceding chapter.

Economic Geography.—In the calculations of economic geography, it should be remembered that commercial distance is not physical distance. Commercial distance is not measured in miles but in terms of cash outlay, time expenditure, risk, inconvenience, and the mental inertia to be overcome. It is a complex of many factors, and it can only be inadequately represented by maps and charts.

To distinguish clearly the economic geography of a region from the physical geography, and to conceive truly the highways of commerce, and the forces which impel or retard the movement of goods and persons over them, is no small revolution of one's customary ways of thinking of space relations.

Location and Freight Rates.—The classification rules and the freight rate structure of American railroads show that the strategic places for the location of industries which involve important assembling and distributing functions are, (*a*) points on competing waterways, especially ocean ports and Great Lakes ports, (*b*) centers at which numerous competing railways converge, (*c*) locations within influential common-point territory, adjacent to the previously mentioned centers, and (*d*) localities so influential in the supply of certain products as to enjoy favorable commodity rates on those articles.

Natural Protection.—There is, of course, a limit to the advantage of any single location. As distance increases, transportation expenses form an increasing natural protection, insuring to a distant competitor relative advantage in his neighborhood. It has been found, therefore, that in the support of national distributive campaigns it is often necessary to operate a series of plants, locating each establishment in such a way that it will command the trade of a district. To whatever office orders may be sent, they can then be filled by the plant nearest the customer. Cross shipments can be avoided; excess stocks can be shifted; and accidents and other interruptions localized.

The Local Market.—The tendency of our commercial evolution seems to be to break down the distinction between a manufacturing East and an agricultural West, and to develop in each region manufacturing and jobbing centers for the supply of the territory lying about them The importance of intensive cultivation of local territory is, therefore, increasing

Estimates of Population.—The market which a community affords for consumption-goods depends upon the population, its wealth, and its habits of life. The rate of growth of any place since the last census can be calculated. The method used is that of arithmetical progression, which is based on the assumption that the increase each year since the enumeration is equal to the annual increase between the last two censuses This figure is calculated each year by the Census Bureau, for all cities of 8000 population and over. The results are available in bulletins issued by the Census Bureau. The figures are, of course, estimates. They will not show whether or not there has been any change in the rate of growth since the last census.

Tributary Territory.—The extent of the surrounding region which is tributary to any village or city is not easily determined. The experience of traveling salesmen, retail merchants, banks, and railroad ticket agents is valuable, but difficult to collect. Rough calculations can, of course, be made from census data, distributing the rural and village population between competing points on the assumption that the attraction of rival centers is inversely as the square of the distance and directly as the size. Accurate mapping of tributary territory has as yet been done rarely by American cities.

A somewhat different analysis of tributary territory abandons distance and turns upon cost, giving the areas or the population accessible at a given freight charge.

From Detroit the freight rates, for less than carload shipments of various classes of freight, to various nearby points, by all-rail routes, are as follows, in cents per 100 pounds: [1]

[1] Rates furnished by courtesy of John McNally, Traffic Commissioner of the Detroit Board of Commerce

Destination	Freight Class					
	1	2	3	4	5	6
Cleveland, O	66½	56½	41½	33½	23½	18½
Toledo, O	47½	40½	32	24	16½	13½
Buffalo, N Y	76	64½	51	38	26½	21½
Chicago, Ill	79	67	53	39½	27½	22
Milwaukee, Wis	88½	75	59½	44½	30½	25
Duluth, Minn	150	125½	96	70½	52	41
Sandusky, O	56½	48	38	28½	20	16
Port Huron, Mich	50	42½	33½	25	17½	14

Style Movement.—It is not natural that the people of a community should purchase style goods from a market which they believe to be one receiving new ideas later than themselves. The law of style movement in the United States is that a new idea passes from east to west, from larger cities to smaller ones, and from neighborhoods of wealth to those of less wealth.

City Measurements.—The statistics of industry have now been so much improved that persons who are studying the characteristics of different neighborhoods can get many general comparisons at little expense from published sources. The Statistical Abstract of the United States is a large volume published annually by the Bureau of Foreign and Domestic Commerce of the Department of Commerce It gives the retail prices of coal, gas and electric power for about 50 cities. It also publishes a portion of the statistics of the cost of living compiled by the Department of Labor, expressed in terms of an index number. The per capita fire losses of principal cities are also briefly given.

After each decennial Federal census a volume entitled Abstract of the Census of the United States is published by the Bureau of the Census of the Department of Commerce. This publication summarizes the information in the larger census volumes. In it can be found statistics of increase of population for all places over 2500 in size, also data as to the distribution as between males and females, as between various age groups, and as between native and foreign born, and between white and colored. The average number of persons to a dwelling is likewise given, from which the crowding of working-class quarters can be inferred. Here also

is a tabulation of the percentage which the school population forms of the total number of persons of school age. Information as to tax rates and per capita taxes paid can be gotten from a digest of state laws on taxation, and from reports on Wealth Debt and Taxation, both published by the Department of Commerce.

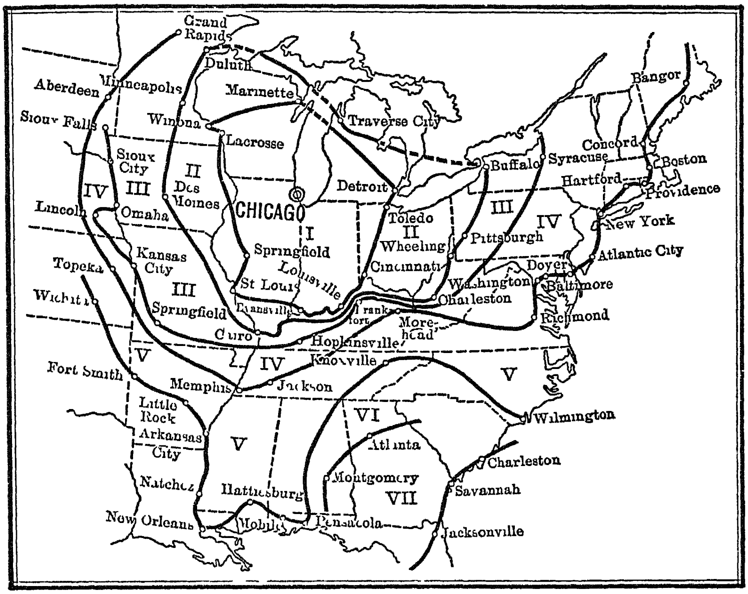

Fig 2—Distance in Terms of Cost

Freight rates from Chicago, first class, in cents per 100 lbs The zones are bounded by cities taking the following rates Zone I, from 65 to 85 cents Zone II, from 89 to 99 cents, Zone III, from 112 to 129 cents, Zone IV, from 135 to 153 cents, Zone V, from 182 to 206, Zone VI, from 218 to 232, and Zone VII, 218½ cents Rates furnished by the Freight Rate Division of the Chicago Association of Commerce

The cost-of-living statistics, in considerable detail, for different localities can be obtained from bulletins, and the Monthly Labor Review, both published by the Bureau of Labor Statistics of the Department of Labor. Information as to building permits, and expenditures for building in principal cities, is given from time to time by the Bureau of Labor Statistics. Figures are also published by the American Contractor of Chicago. Complete data are

furnished to subscribers by the F. W. Dodge Company of New York City.

Fire losses are annually summarized in the report of the Committee on Statistics and Origin of Fires of the National Board of Fire Underwriters, located in New York City. Bank clearings for the chief cities are published by R. G. Dun & Company in Dun's Review, the annual statistics appearing early in the year.

The statistics of schools are very completely presented in bulletins issued by the Bureau of Education of the Department of Labor President Nicholas Murray Butler of Columbia University has said, " Where the public school term in the United States is longest, there the average productive capacity of the citizen is greatest." The percentage of children of school age who are actually in school is important as it is an evidence of the quality of the labor force which is in preparation for to-morrow The severest test of the school system is the percentage of the children of foreign-born parents who are in school. All government departments respond generously to requests for information; and government documents are sold at merely nominal prices.

Factory Sites.—Manufacturing sites in cities of from 20,000 to 100,000 population are worth from $1000 to $5000 per acre, without trackage, and from $2000 to $50,000 per acre with trackage.

The larger the size of a city the more stable the price of any given class of manufacturing sites becomes, and the more easy it is, therefore, to borrow money on such real estate. The offsetting advantage of country location is that lower prices per square foot allow the works to be spread out so that the fire hazard is reduced, and a free use of one-story structures can be made.

In an increasing number of cities there are being opened " Industrial Districts," comprehensively planned, and connected with belt railway lines. Chicago, Kansas City, Minneapolis, St. Paul, and Brooklyn (in the Bush Terminal Station) provide examples Such districts facilitate railway car and auto truck movement. They especially aid in the difficult problem of less-than-car-lot shipments, by providing local trap cars to gather packages of mixed destination, and move them daily to the freight terminals, where package cars are loaded to serve certain zones of each line of railway.

The Factory Site and the Wage Earning Population.—In the choice of a particular site the convenience of the factory operatives is perhaps the leading consideration. Mr. Henry T. Noyes, whose plant, Art in Buttons, is a model establishment in Rochester, has emphasized this point.

"Most concerns think only of cheap land and go to the outskirts of the city and buy real estate there. In locating a plant, it is very important to consider the type and character of the workers likely to be employed. If high-paid, skilled men are engaged, a plant might, to very good advantage, be located on the outskirts of a city because men earning very high wages will not hesitate to go any distance to work. Furthermore, such men are home builders and will in time build or secure homes near the plant. In case a concern uses chiefly girl labor, or boys and girls and a good deal of unskilled labor, then great consideration must be given to its accessibility to employees. The importance of this feature can be emphasized when we realize that a concern may pay more in one year for extra wages than the ostensible saving on the cost of the land. The first cost of the land is a very small consideration when one figures what it may be necessary to pay out annually in wages by reason of a wrong location. When employees have to pay sixty cents to a dollar per week for carfare and have to take with them or buy their lunches, they expect to get paid for it.

"Many instances are known where plants on the outskirts of the same city are paying girls one dollar per week more than are other plants rightly located near the home of the workers, the difference being due solely to difference in accessibility. Furthermore, people do not like to waste thirty to sixty minutes going to work and a similar period coming home. They give preference to a business which is within easy walking distance. Accessibility thus gives help at a lower wage and gives the pick of the best help. For a plant having approximately a thousand employees, one dollar per week additional in wages, because of poor location means over $50,000 loss per year." [1]

A study of the daily to and fro traveling of employees was made several years ago by the W. H. McElwain Shoe Company,

[1] Henry T Noyes, Planning for a New Manufacturing Plant, Annals, Sept, 1919, Vol. 85, p 70.

at their Boston plant. They found that the average going and coming times, taken together, were 83 minutes per day. During this time the employee was usually standing, and usually in bad air. The weekly schedule of time away from home was: Working time 48 hours, traveling time 8 hours and 18 minutes, total time 56 hours 18 minutes. At their Manchester, N H, plant this company found the going and coming time to be about two hours per week, for those employees who chose to live in the residence suburb in which the plant is located. The weekly time engaged was thus 48 hours of working time, and 2 hours of traveling time, or a total of 50 hours. There was a saving, as compared with the Boston plant, of 6 hours and 18 minutes per week.

At a foreman's meeting of the Lever Bros. Co, in Cambridge, Mass., in 1919, the average going and coming time of the foremen was found to be 55 minutes per day. This indicated a weekly schedule of 48 hours working time, 5 hours 30 minutes traveling time, or 53 hours and 30 minutes total time.

This matter of a location inconvenient for the factory operative is pungently summarized by Whiting Williams as follows: "Few managers seem to realize how a worker figures—and begrudges—the minutes and hours he uses to go and come. Besides frequently causing the "passing up" of the distant job, it looks as though all those minutes—like all the drops of sweat—figure sooner or later in the worker's bill against his employer, and so in the cost of production, and, finally, of living, for everybody to pay." [1]

The Location of Retail Establishments.—The location of mercantile establishments in a city is primarily based upon the fact that the central point of a settled area (uneven topography aside) is the point most accessible to customers If the existing retail center is not near this point, that is to say, if the city has been growing more rapidly in some directions than in others, the retail district will be found to be in a slow process of travel toward the center of population, inferior stores, small repair shops, and abandoned buildings marking the off-side, while new specialty shops mark the approach toward the main residence district. Within the shopping district the universal providers, such as the

[1] Whiting Williams, What's on the Worker's Mind, N Y, 1920. Scribners, p 227

department stores, and the better managed institutions which are able to utilize high densities of traffic to best advantage, will be found occupying the best central locations, while single-line shops of narrow appeal, and the less efficiently managed stores will occupy the side streets and the outskirts of the shopping district.

Within the shopping district a store will seek the neighborhood of stores of its kind, or stores which appeal to the same class of customers. The habit of the customer, when bent upon a particular errand, is first of all to place himself or herself in the quarter where there is the best combined assortment within a street frontage of a few hundred feet. The customer will then shop around from store to store, going to outlying stores only after the stocks of the chief group have been examined. Most shopping streets, especially in medium-sized and small cities, will be found to have one side devoted to women's trade and occupied by dry goods stores, jewelry stores, furniture stores, and the like; while the opposite side of the street will have the hardware stores, barber shops, and cheaper restaurants. There is a slight tendency for the woman's trading center to be on the south side of an east and west street, to secure the advantage of shade. There is also a slight tendency for this center to occupy the side of the main street which lies nearer to the best residence district. Mercantile values are injuriously affected by vacancies, buildings in course of construction, and by non-mercantile buildings, such as a church or court house. They are also injuriously affected by slopes which materially increase the effort of movement on foot or in vehicles.

When a city reaches such size that a couple of hundred families live at a distance of approximately a half mile from the chief shopping center, there is likely to be formed a neighborhood-convenience sub-center, consisting of a grocery store, a meat shop, and a drug store in which the sale of soda, cigars, and magazines and newspapers helps out the prescription trade. With the continuance of growth, such sub-centers tend to arrange themselves at half-mile intervals on the chief lines of radial travel.

Changing Conditions.—Industrial conditions are in a rapid state of change, so that it is not to be expected that a locality will always retain the same degree of advantage. High freight rates are now moving some producers nearer to markets. Exhaustion of raw materials is dispersing others to new locations. Factory

legislation still exerts some pressure to send capital into the less progressive sections The center of population continues to move westward; and western competition is increasing. The Pacific coast is increasingly taking care of its own requirements. Coal is high in price. Fuel oil is practicable. Electric power is expanding its field rapidly through the growth of central station service. The increasing expenses of city trucking, of delay at congested terminals, and the other influences mentioned in the discussion of the dissemination of manufacturing establishments, are forces building up satellite cities. Therefore, we may say that, from time to time, the problem of location must be restudied by any industrial organization.

Problems

The Persistence of the Small Establishment.—On the basis of the centripetal influences which are listed in the text, under the paragraph heading "Separation from Other Manufactures," and with your own additions to the list, study the following catalog of industries, each of which is notable for the number of small establishments. Indicate for each industry the influence which, in your opinion, favors the small establishment If more than one influence applies, indicate the important ones in the order of their power.

Artificial limbs
Artificial stone
Automobile repairs
Awnings and tents
Baking powder
Baskets
Bookbinding
Bakery products
Brooms
Blacking
Boats (small)
Bluing
Boxes (packing)
Brushes
Canning and preserving
Carpets (rag)
Carriages and wagons manufacturing and repairing
Cleaning and polishing preparations
Confectionery and ice cream
Cooperage
Copper, tin, and sheet-iron work
Cheese
China decoration
Coffee and spice roasting and grinding
Corsets
Cutlery and edged tools
Dental goods
Druggists preparations
Electroplating
Enameling
Engraving
Fireworks
Flavoring extracts

Flags and banners
Flour mill and grist mill
Foundry and machine shop
Fur goods
Furniture
Hair goods
Ice manufacturing
Inks (writing)
Instruments (scientific and professional)
Jewelry
Leather goods
Marble and stonework
Millinery
Mineral waters and soda
Mucilage and paste
Optical goods
Patent medicines
Perfumes and cosmetics
Printing
Publishing
Planing mills and cabinet work
Sausage manufacture
Stamps (hand)
Saddlery and harness
Scales and balances
Showcases
Signs
Slaughtering and meat packing
Sporting and athletic goods
Stencils
Structural iron work
Surgical appliances
Suspenders and garters
Screens (door and window)
Tobacco manufacturing
Toys
Umbrellas and canes
Washing machines
Whips

Rating of a City for Manufactures.—Rate the city in which you are located, or a city of which you can get adequate information, as a point for the possible location of manufacturing institutions In conclusion indicate for what lines of manufacture the place appears to offer the greatest attractions Consider the following matters, but add to the list such other points as you find to be essential.

How far distant from cities of 50,000 population or over in various directions?
What raw materials are produced in quantity locally?
How far away are the mines which furnish steam coal? What is the average B t u per pound of the coal used? What is the freight rate per ton in carloads for coal from a representative supplying point in the mining district? What is the local price of steam coal in carload lots on track?
What is the cost of central station power to large consumers?
Does local water conform to U. S. Treasury Department requirements recommended for use on a common carrier?
What is the average summer and winter humidity?
What are the food-producing resources of the country for 50 miles around?
Is there a local trade school or manual training high school or technical school or college?

Are the trades on an open or closed shop basis? What restrictions on production are enforced by the local unions? What is the strike record?

What is the character of the housing accommodations available for wage earners? How convenient or inconvenient are wage earner's residence sections to industrial property?

What is the estimated public warehouse capacity. sprinklered, non-sprinklered, refrigerated?

Is the place a rate-breaking or a terminal railroad town? Is it an interchange point for cars, or a point on the natural route for the return of cars under the per diem rules? How many package cars for L C L freight leave the city daily?

Can commodities be brought in from various territories, and milled, stored or cleaned in transit? Are there numerous commodity rates in and out?

To what extent does a spirit of enterprise and cooperation, in the promotion of community interests, animate the population?

Location versus Scheduling.—Two wholesalers are in competition for the patronage of a retailer in Cincinnati. One is located in New York City, and the other in Chicago. Each house receives an order at the same hour—on Monday at 9 A M.—the New York house on Eastern time, the Chicago house on daylight saving time, one hour faster than central time.

The New York house passes the order through to the shipping department in two hours. There is a delay of thirty minutes in telephoning the order to the New Jersey warehouse. There the stock picking occupies thirty minutes. It takes one hour to check, invoice, box, mark, and prepare bills of lading. There is a thirty-minute wait for trucks. The truck loading, running, and unloading time is one hour. Package cars for Cincinnati are closed at 9 A M. and 3 P M daily. The average running time from New York to Cincinnati is forty-eight hours. No work is done in the New York office nor the New Jersey warehouse from 12 to 1. The day begins at 8 A M and closes at 5 P.M

The Chicago house employs three hours in preparing papers, and in passing the credit, before the order reaches the shipping department. There is a delay of one hour before the order is taken up by the stock clerks The picking, checking, invoicing, boxing, marking, etc., occupy two hours An equal time is absorbed in draying by team to the freight house. In Chicago the Cincinnati cars are closed at 10 A M., 1 P.M., and 4 P M. The average running time to Cincinnati is thirty-six hours. No work is done at the Chicago house between 12 and 1. The day begins at 8 A M. and closes at 5 P.M.

The Cincinnati freight house is open for deliveries at 6 A.M. It closes at 6 P.M. At what time did each of these suppliers get his shipment into the hands of the Cincinnati buyer?

After making the solution, bring out the significance of certain time junctures which may be discovered by following the schedules of operations back from fixed points such as mail delivery, business hours, time of closing cars, etc. What suggestions can be made to the slower house?

The House Schedule versus The Railroad Schedule.—A lot of merchandise is lying on the shelves of the fourth floor of a warehouse belonging to a manufacturing company in Chicago. On Monday morning at 8 o'clock the postman delivers a letter containing an order for one ton of these goods to be shipped to Wheeling, W Va. The company uses automobile trucks to move small lots to the railroad platform one mile away. Package cars for Wheeling are closed daily at 9 A M. and 1 P.M Running time for these cars may be estimated as at the rate of 150 miles in each twenty-four hours. Construct two schedules, one that of probable average practice, and one representing first-class practice. In these schedules trace operations in as much detail as your information will permit State, finally, in the comparison of the two schedules, how much further away in miles (equating time into freight movement at 150 miles per twenty-four hours) the slow schedule puts a house from Wheeling than the fast schedule does.

Fast and Slow-growing Towns.—If it is desired to locate a retail store in a fast-growing city, what advice can be offered? Secure the Census Bulletins showing city population figures for the latest five-year interval available. Select, first, cities with population between 40,000 and 75,000 and advise which are the 10 fastest growing cities in the United States, and which are the 10 slowest growing cities. Next, select cities of from 100,000 population to 250,000 population, and advise which are the 10 fastest growing cities, and which the 10 slowest growing cities. Are there any reasons to think that, in any individual cases, these classifications do not do justice to the cities included, on the score of the real dynamic force of the places?

Factory Sites and Wage Earners' Residences.—In Indianapolis there has been a movement to employ wage earners as near to their places of residence as possible. If the information can be secured, from the payroll department of a local manufacturer, with which to plot the residence locations of employees, plot the same on a large scale map Each employee should be represented by a dot on the map The dots should be as nearly as possible of the same size Approximate location (location within the block) should be sufficiently accurate The location of the employing plant should be made prominent on the map. All other matter,

such as street indications, names, etc., should be inconspicuous, or put in a different color.

πR^2 Map of City Population.—Prepare a large-scale map of your state, or of a territory with a chosen radius from any desired location Upon this map indicate the location of cities and villages. Ascertain the population of these places from the latest statistics made available by the Census Bureau. Each city or village should be indicated by a circle filled in solid with India ink. The areas of these circles must be made proportional to the population of the places they represent, in order that the map shall accurately convey the idea of the distribution of population For instructions as to the preparation of this map see the note following.

Note on the Preparation of πR^2 Maps.—Any set of quantities can be given accurate geographical expression by the use of πR^2 maps Thus, not only the population of cities can be shown, but the productive capacity, or annual production, or capital invested, or average wage earning population employed, by localities for any line of industry. Such data can be secured in wide variety from the trade directories and from Census Bureau reports To obtain the proper length of radius of the circles, the square root of the numbers desired to represent can be taken, and this in turn divided by the value of π(3 1416). To facilitate this calculation the numbers should be reduced to terms of thousands or millions, and a table of square roots used for the simplified series Such tables may be found in handbooks of engineering data. There is one in Management's Handbook, N. Y., 1924, Ronald, pp. 23–32. When the numbers representing the relative lengths of the radii have been derived, they can be interpreted into terms of any desired fractions or multiples of an inch for plotting with the compasses. It is important to determine the maximum size of circle permissible, by tentative work on the map in pencil in the region of greatest congestion of data. If a considerable number of maps of this type is to be prepared it is advisable to prepare a graph of the πR^2 scale so that distances can be taken off directly with the compasses As an alternative to this a tabulation of πR^2 values can be calculated to cover the numbers to be used Much time can be saved if large-scale outline maps can be purchased of local stationers.

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CHAPTER IV

LAYOUT OF A MANUFACTURING PLANT

The Problem.—The planning of an industrial works is much like the planning of a farm, or a garden, or a residence, or even a kitchen,—for a kitchen is a workshop It has points of similarity with the planning of a city. In each of these cases there are certain functions to be provided with space requirements, which functions must sustain definite relations of area and direction with each other. The functions of an establishment, of course, vary greatly in individual significance They vary also in the degree of handicap they will suffer from lack of adequate space and position. The problem of layout is to discover such an arrangement as will secure the greatest convenience for the most important functions. To state this a little more fully, we may say that the optimum plan is the one in which a series of quantities representing the importance of the various functions, multiplied by quantities representing the advantage secured for those functions by space and location, will amount to the greatest possible sum

The points which are most likely to be decided upon by the management before serious work is begun upon the layout of the plant are, that a given sum of money can be devoted to the enterprise, or that a given output is to be provided for, or that a certain piece of land is to be used. One, two, or three of these matters may be settled in advance, so that the layout studies will be more or less of a compromise

The preparation of a plant layout begins with a detailed engineering analysis of the article to be manufactured This study is to reveal the component parts, and the necessary manufacturing process (physico-chemical steps in proper sequence) for the production of each part Each process is then to be studied, to determine what machinery, equipment, crafts, and skills will be

required. A single process with its workman, mechanical equipment, and spaces for stock, is a production center,—the ultimate manufacturing unit. The space requirements of such units should be worked out in detail. An assemblage of like or closely connected production centers, handled as a single administrative unit, and embracing not only production centers but supplementary centers for administration, communication, and the like, constitutes a shop. The manufacturing shops, together with special centers for power, general administration, and a variety of service departments, constitute the elements of the plant. These elements must be grouped into buildings and yard areas, arranged in a general plan of layout.

The conception of a modern plant, from the point of view of layout, is of a huge machine or mechanical leviathan; slightly adjusted in the process of fitting it into a series of buildings; designed and assembled much as a machine would be; and performing its function (much as a machine), in so far as it works smoothly, as an intimately coordinated whole.

A Smooth Flow of Work.—A proper plan conforms to economy by insuring complete utilization of buildings and grounds, and by facilitating the movement of material from process to process; but it avoids the parsimony of condensing things to such an extent as to produce a cluttered shop with its impeded movements and its perpetual rearrangements to make room. An uncomfortably crowded shop prevents employees from making rapid and free movements, and forces them to employ slow and inefficient movements and assume cramped positions. It increases the risk of accidents, because of the closeness of the operatives to the machinery, and the piling of materials to undue heights. It necessitates much rehandling and repiling of material, and prevents the introduction of ample apparatus, such as containers and trucks, for the saving of labor in handling materials. A crowded condition makes it much more difficult for the foremen of the shops to keep track of the progress of work.

If things which have reached a certain stage of completion have a definite area reserved for them, and if all work which has reached this stage can be accommodated in the assigned area, then the floor of the shop, with its distribution of materials, is always a kind of magnified graphic chart of the state of the

schedule. Management is obviously much simplified, if it can be taken as a *prima facie* evidence of inadequate performance, when there is an undue accumulation of material at any point.

Straight-line movement of work means the greatest simplicity and clearness. It also means the shortest total length of aisles, and hence the highest ratio of floor space engaged in actual fabrication. The more the materials are moved about, the more shaking and rumbling there is to distract attention, the more the finished surfaces of the product suffer from bruising and scratching, and the more skilled artisans are engaged in movemen's work.

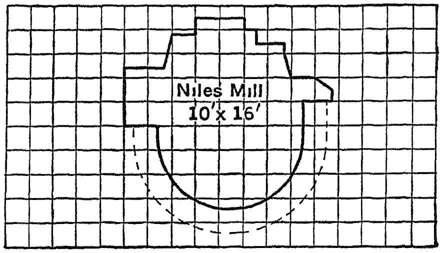
The Production Center.—The analysis of a production center raises the questions: What areas are to be required, and to what uses are they to be put? If there is a machine, what are its over-all dimensions, including allowance for the extreme outward travel of all moving parts? If the chief piece of equipment is a work bench, what are to be the length and width? What space must be kept clear around the machine to allow the operative to feed and remove stock, and make adjustments? What additional allowances must be made on all sides for main aisles and cross aisles? What spaces are needed for belt-ways or containers? What space is to be allowed for incoming and outgoing stock? It will facilitate matters if standard determinations, applicable to many production centers, are made for such things as the width of aisles, or the width of work benches.

Before production centers can be arranged into shops it is necessary to consider other requirements. What, for example, does the center under consideration require in the way of overhead or ceiling height, crane service, industrial railway trackage, live steam, light intensities, and access to shafting? What weight per square foot of floor space will the equipment and stock involve? How exacting is the process as to floor alignment? How many workmen are to be accommodated?

It will facilitate matters to prepare memorandum pages upon which the layout requirements of production centers can be recorded. On such a page an outline drawing to scale can be made. Below this the various requirements of the center can be recorded under standard headings. A suggestion toward the construction of such a memorandum is as follows:

MEMORANDUM ON PRODUCTION CENTER

No. *9* Dept *28*



SCALE
Each square is ______ inches on a side

Name of process or symbol **MVRC23**

Equipment. *Niles Mill 10'×16' Model X, 1917.*

How may centers like this one *2*

Operatives *Machinist and two handy men as helpers*

Lighting requirement *General 2 f c on spaces ______ 4 f c*

Crane service *Local jib Under 5 ton traveling*

Area of equipment ______ sq ft

Power requirements *Individual electric drive*

" maximum *k w h*

Driving pulley ______ r p m.

Areas to handle work *See dotted lines on diagram*
(Indicate on diagram)

front ______ back ______

right ______ left ______

Special access ______
(Indicate on diagram)

FIG. 3 —MEMORANDUM OF REQUIREMENTS OF A PRODUCTION CENTER

In a similar manner analysis will cover every part of the offices, warehouses, and yards.

Sequences.—Another problem of layout is to determine the location of each center with reference to other centers, so that it will be in its proper position in the sequence of processes and the movement of materials. Some industries comprise a single simple chain of performances which may be represented by Figure 4. The material moves straight on, as in a paper mill, from one

process to another, until the end is reached Other industries involve a number of separate sequences which move along in in parallel series to form, perhaps, a trade assortment.

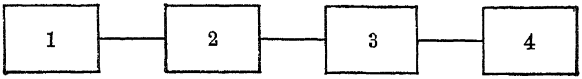


FIG 4.—SIMPLE SEQUENCE

Still other industries, such as slaughtering and meat packing, consist of the subdivision or disintegration of a complex raw material, until it is differentiated into a large number of separate commercial products, as in Figure 5.

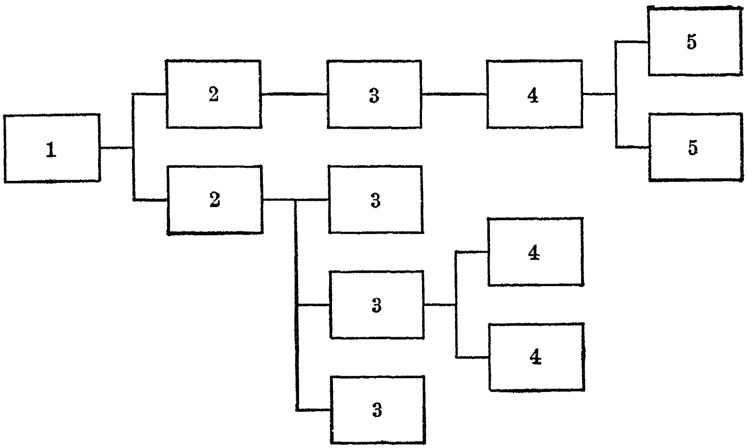


FIG 5 —ELABORATIVE SEQUENCE

One of the commonest manufacturing processes involves the manufacture of parts which may individually run through longer or shorter series of simple sequences, to be then grouped into minor assemblies, which in a final synthesis take their places in a complex completed product, as in Figure 6.

Coordination.—In order that all parts of an establishment may be kept full of work and under even pressure (a condition essential to the development of a uniform habit of the shop), it is necessary that each class of production center should coordinate in capacity with those centers which precede it or follow

it, and which must therefore either supply it with work or take work from it. If we imagine a manufacturing process consisting

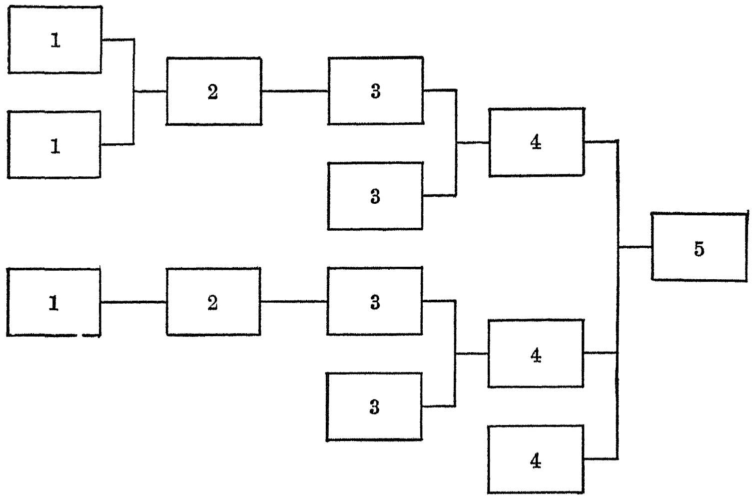


FIG 6 —ASSEMBLY SEQUENCE

of three stages, designated as A, B, C, and diagrammatically represented as in Figure 7.

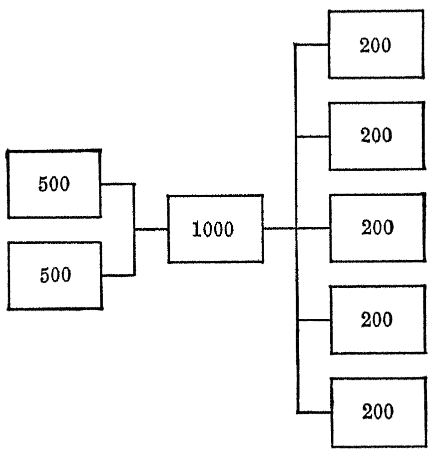


FIG. 7 —DIAGRAM OF COORDINATION.

it will be obvious that two machines of 500 capacity for *A* will fully employ a machine of 1000 capacity for *B*, and five machines of 200 capacity for *C*. If we install a *B* machine of 1300, in the best adjustment possible we shall either lose 200 on *A* equipment and 100 on the *C*, or else lose the 300 extra capacity in the new *B* machine. If a *B* machine of 1400 capacity be installed, we shall lose 100 on *A*, in the best possible adjustment. Not until we equip all the processes for 2000 can we again obtain as good a correlation as was had at 1000. A rule of perfect coordination is that the total capacity of a series of connected manufacturing departments should be some common multiple of the capacities of the individual production centers composing those departments.

Transportation and Layout.—The transportation problem of a manufacturing plant appears to divide itself into three parts: first, the movement of materials by the operative within the production center; second, the inter-center and inter-shop movements which are in charge of a special force of movemen; third, the transportation which takes place over standard-gauge railway track within the company's property.

In internal transportation the complete journey is from tool point to tool point The most expensive type of transportation is the manual handling which takes place at the production center, as when the operative picks up his stock, piece by piece, and moves it a few inches or a few feet, in the process of manufacture. There is much inefficiency hidden in this world of manual manipulations, which has been left to the discretion of the individual workers. It is the object of motion study and time study and fatigue study to inquire into the intimate and particular layout of the individual production center, with the idea of economizing effort.

The costly elements, in these handling journeys, are the vertical ones. When the trunk of a workman's body must be bent for each piece, the efficiency of the energy expended must be a very small decimal. The aim should be to keep all handlings as short as possible, and keep them in the same horizontal plane. A few horizontal planes should be established for work throughout a shop, and change from one plane to another should be made in large lots by means of appropriate mechanical apparatus, such as elevating trucks or tiering machines. The ideal in handling eco-

nomics is to have the final position of a piece of work, at the conclusion of an operation, serve as the initial position for the next operation. As such a condition is rarely attainable, the practical ideal should be to reduce journeys between tools, as far as possible, to three parts (*a*) a single short detail handling from tool to container, (*b*) a transfer trip of a quantity of articles from the delivery position to the receiving position, in an easily propelled container, (*c*) a short detail handling from the container to the next tool.

Inter-center and inter-shop transportation has been the province of the hand truck. The truck has undergone a considerable evolution in recent years. Bodies of every imaginable shape—boxes, racks, pigeon holes, hooks, etc ,—have been devised to accommodate different kinds of material in such a way as to minimize handling, protect finished surfaces, and assist in accounting for quantity. The greatest improvement in the hand truck is the elevating truck, which slips under a standard base, lifts the base a short distance from the floor, and moves it, with whatever containers may be piled upon it, without disturbing the stock. Motor-driven trucks—electric or gasoline—are now used wherever the loads and distances warrant; and these are taking the place of indoor and yard narrow-gauge track, much as the auto truck on city streets is supplanting street railways.

Of standard gauge railway transportation within industrial grounds, it is only necessary to call attention here to the point that in heavy manufacturing on a large scale, where long strings of cars must be moved, it is desirable to shorten the arcs of railway curves by arranging buildings in such a way that the main axis of the individual buildings (or of a series of buildings placed in echelon or stepwise arrangement) shall be approximately at an angle of 45° to the main lines from which the yard tracks are taken off.

The first arrangement illustrated in Figure 8 is followed by the Buffalo and Susquehanna Iron Company of South Buffalo. The second arrangement is followed by the Westinghouse Electric and Manufacturing Company at Lester (South Philadelphia), Pa.

In laying out standard railway tracks a minimum radius for short arcs is 100 ft., for longer arcs 150 to 200 ft. It is desirable to arrange easy curves, to separate receiving from shipping switches, and to tie the crane service and the industrial railway

service together by judicious interlacing But it is wise, also, to avoid running railway tracks through buildings, and to avoid arranging the walks and roads which must be followed by workmen in such a manner that tracks must be crossed near doorways or near the corners of buildings.

Layout and Power Requirements.—In the days when direct-connected water wheels were the reliance of large manufacturing establishments, mill architecture and yard layout were influenced by the cramped spaces into which factories squeezed themselves along the river banks. Streams of rapid fall commonly have deep beds, and little level ground between the high banks and

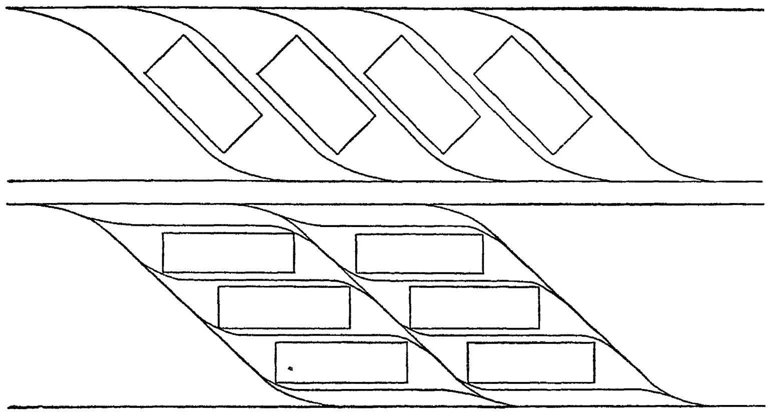


FIG 8.—SHORT-ARC ARRANGEMENT OF RAILWAY CURVES

the water's edge. The narrow sites of the old mills, together with the restrictions imposed upon length by the heavy, slow-moving shafting, made necessary upper stories, and confirmed the first mill type as a narrow, tall structure.

When the production of large fly wheels began to reduce the pulsations of the steam engine, and the Corliss method of regulating the engine by varying the point of cut-off at last made this source of energy steady enough for spinning and weaving, the manufacturers found their mills liberated from the thraldom of the waterway The imperfection of belts and the shortness of lines of shafting still kept the shops huddled closely about the power plant, however. With the advent of electric trans-

mission all dynamic connection with the power house is at length severed, and the architect is free to group his departments on new principles of arrangement. The use of group and individual electric drive for the machines in the shops has largely liberated layout from the long parallel lines of floor directly below the lines of shafting, so that arrangement can now consider, chiefly, convenience in the flow of work.

The Layout of Shop.—On the basis of the known space requirements of production centers, and the sequence of processes, and taking into due account the laws of coordination and transportation, a process-area-diagram can be constructed. But before the centers are grouped into shops, it is necessary to ascertain the requirements of each process as to light, shafting connections, headroom, crane service, special foundations, and the relations which are to be sustained with every type of administrative and service department, so that in the final adjustment these needs will receive consideration. It is also necessary, in laying out the plans for a shop, to allow space for the foreman's office, for stairways and beltways, and intermediate storage spaces and toilet rooms.

It is desirable to arrange a shop with its main axis east and west, so that the light will be received from north and south windows. This is particularly true for fine manufacturing, for by this plan one side of the shop will be insured a north light, and all parts of the shop will have reasonably uniform natural lighting from hour to hour throughout the day

A problem arises, in organizing a series of shops, as to the proper location for work of a given kind, which occurs again and again at different stages in the process of manufacture. Should such work be done at the various points where it occurs in the regular line of advance, with the necessity, perhaps, of installing the same kind of machine in two or three shops? Or should all work of a kind be done in one place, even though it be necessary to shift materials back and forth? If the first plan is followed, as is the tendency in mass production—the dominant thing will be a straight-forward progression. If the second plan is followed,—as usually happens in specialty manufacturing,—the controlling motive will be to secure the advantage of massing all of one kind of machinery, labor skill, and administrative experience

in one place. The usual solution of this problem is a compromise, which may be defined briefly as straight-line movement of materials when they are handled in quantity, while at the same time expensive units of equipment are kept in operation as steadily as possible.

Arrangement of Shops to Compose a Plant.—The elements of which manufacturing establishments are composed may be listed as, 1, Raw-material storage, and finished-product storage. 2, Intermediate storage. 3, Manufacturing centers. 4, Assembling rooms and erecting floors. 5, Tool room, grinding room, and repair shop. 6, Stairways, beltways, elevators, and halls. 7, Toilets, lockers, and rest rooms. 8, Drafting room. 9, Planning room. 10, General offices. 11, Power plant. 12, Yard departments.

Service Centers.—It is profitable to group certain of the ser-

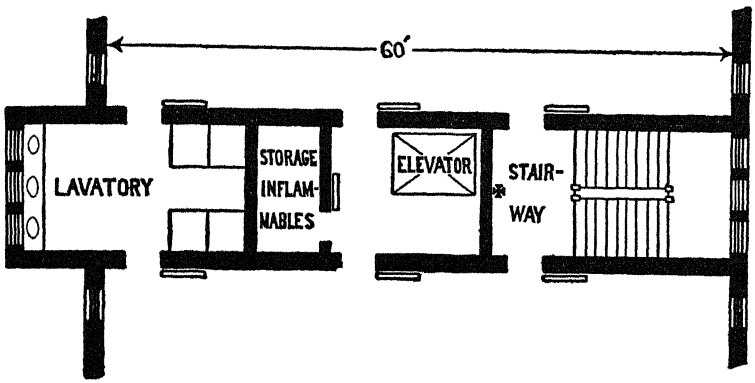


FIG. 9.

Plan showing the grouping of service centers between fire-proof walls, separating two shops All doorways protected by self-closing, fire-proof doors. ✠ = fire plug

vice departments, the sanitary accommodations, and the spaces reserved for transportation and communication, in the form of narrow bands between the shops, and enclosed between fire-proof walls By this arrangement the shop areas are broken up as little as possible, building space is economized, lighting is improved, and the hazard of fire is decreased. An illustration of such a grouping is Figure 9.

A similar plan, including beltways, is recommended by the Boston Manufacturers' Mutual Fire Insurance Company. See Figure 10.

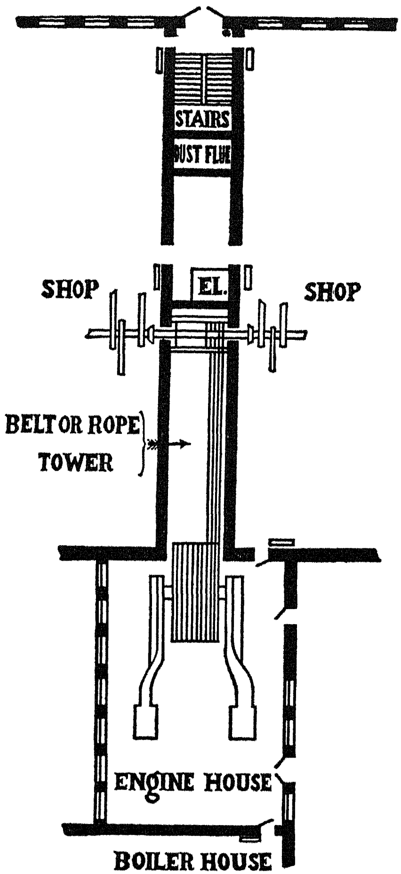


Fig 10

An arrangement of beltway, elevator, and stairway recommended by the Boston Manufacturers' Mutual Fire Insurance Co

At the Art in Buttons plant in Rochester, N. Y.,—a reenforced concrete construction,—there are no stairs or elevators in the main buildings. These, together with the toilets are grouped in separate tower buildings. This arrangement gives larger unbroken floor spaces for manufacture; and it permits each floor to be more nearly isolated as a fire risk.

Segregation.—Since a group of associated departments will suffer from noise according to the noisiest one, and will take the insurance rate of the most hazardous one, there is economy in sorting out departments so that birds of a feather will flock together.

Yard Departments. — A factory yard is a group of unroofed departments, together with space reserved for future growth, which is meanwhile used for lawn and flowers and shrubbery to relieve the ugliness of an unadorned industrial district. Yard layout can be as intelligent as the layout of a factory floor. Yard storage can be much like a warehouse without a roof. Generous room for storage permits buying in large lots. It facilitates

mechanical handling, by allowing storage spaces to be laid out as a series of rectangles within reach of track and crane. And it reduces to a minimum the handling which is incident to rearrangement.

Provision for Expansion.—The symmetry of the original plans of many maufacturing establishments in this country has been spoiled by reason of the fact that an inadequate allowance was made for growth so that, when expansion did come, it was necessary to crowd intermediate buildings in between the original structures, cut off light and air by connecting structures, and complicate the routing plan by tacking on dependencies here and there.

Mr. Henry T. Noyes has made a convincing statement on this point "No point is of greater importance in connection with a new plant than proper and adequate planning for future expansion. This should be considered in connection with every step taken—the purchase of land, the installation of sewers, water pipes, mains through the buildings, the design of the power plant, and all other features In planning our buildings we spent eleven months of preliminary work before we bought any land. We secured from the leading insurance groups of the country a list of the one hundred and fifty light manufacturing plants carrying the lowest insurance in the United States, and a list of plants which, in whole or in part, had been built within the preceding seven years. We visited one hundred and thirty-two of the one hundred and fifty plants and compiled a little summary booklet covering every plant and every essential detail in each plant, thus determining at the time, as nearly as possible, what was 'standard practice,' as to every feature. Eighty-nine out of the one hundred and thirty-two concerns told us that their chief mistake, as evidenced in the seven years, had been failure to provide adequately for future expansion in one direction or another"[1]

Preservation of Market Values.—If a plant is constructed in a large city, where the sale of manufacturing buildings is possible, and where the shifting of population causes frequent changes in the functions of localities, consideration should be

[1] Planning for a New Manufacturing Plant, Henry T Noyes, Annals of Am Acad of Pol and Social Science, Sept, 1919, Vol 85, p 68

given to the preservation of the real estate values or sale values by building structures which can be adapted to a variety of uses with a minimum of remodeling. What this implies in the way of design may be ascertained by the study of the loft buildings now being constructed for leasing purposes in large cities. As country or surburban plants are usually salable or rentable only at a great sacrifice, it is probably wise to give them the most perfect possible adaptation to the primary purpose, and stake everything on the original venture.

Ground Plans.—Mr. Noyes summarizes good layout plans into seven types. "The types of buildings possible in selecting an arrangement to meet given conditions are represented by the capital letters **L, T, U, C, H, F, E.** In all these types of buildings, materials and parts in process of construction may travel in two or mor edirections without re-entrant lines on their way toward final assembling. Moreover, different lines of goods can be made in the various wings without interference, and brought to a common point for storage and shipment."[1] Mr Lansburgh lists **U, L, H, T,** and **E** plans as easy to enlarge.[2] The principle of easy enlargement appears to be what we have called the unit principle. This is in use when a manufacturing establishment is divided into a series of units, each unit having a relatively independent structure, and having open space reserved adjacent to it, so that it can be added to without encroaching upon any other unit. Such a plan D. S. Kimball[3] speaks of as sectional, like a bookcase, so that additional units can be constructed at any time, without disturbing the system.

There is another idea which appears to underlie good arrangement, in some cases at least. It is that the main direction in which extensions can be made without destroying the original plan will be lateral to the main direction of the progress of work for the plant as a whole. Enlargements may be at right angles to this main axis, and on either side of it. The illustrations

[1] Planning Buildings for To-morrow, Henry T Noyes, Factory, May, June, July, 1909, p 24

[2] Industrial Management, Richard H Lansburgh, N Y, 1923, p 126 Wiley

[3] Principles of Industrial Organization, D. S. Kimball, N. Y., 1913, p 242. McGraw–Hill

of projected enlargements, here roughly sketched, will better define the idea

The I Plan.—The simplest type of manufacturing plant is a

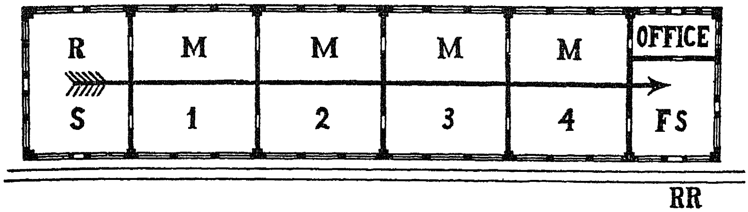


FIG 11—I PLAN

R S =Raw material stores
F S =Finished stock
M 1, 2, 3, 4=Manufacturing departments in order of sequence
R R =Railroad siding

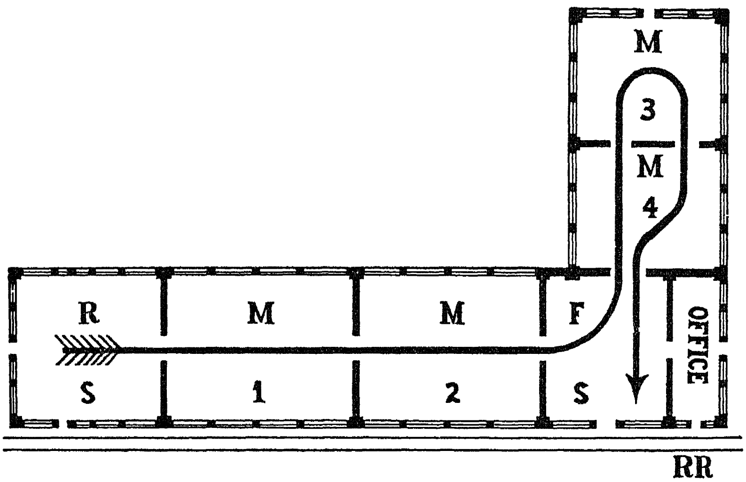


FIG 12—L PLAN

single building of a width consistent with efficient lighting, and of a length depending upon the floor space to be provided Such a plan may be illustrated, in abstract form, by Figure 11

L and U Plans.—The enlargement of an **I** plan is likely, at first, to produce some sort of an **L** or **U** plan, from the necessity of turning to avoid property limits

Accretionary Plans.—Further enlargements are then likely to give evidence of the breakdown of the plan, and to produce

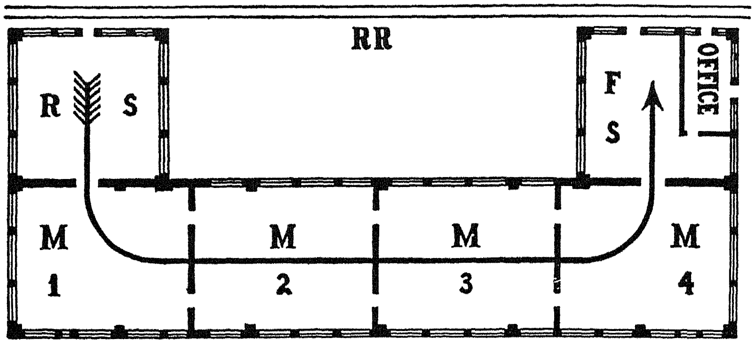


FIG 13.—U PLAN.

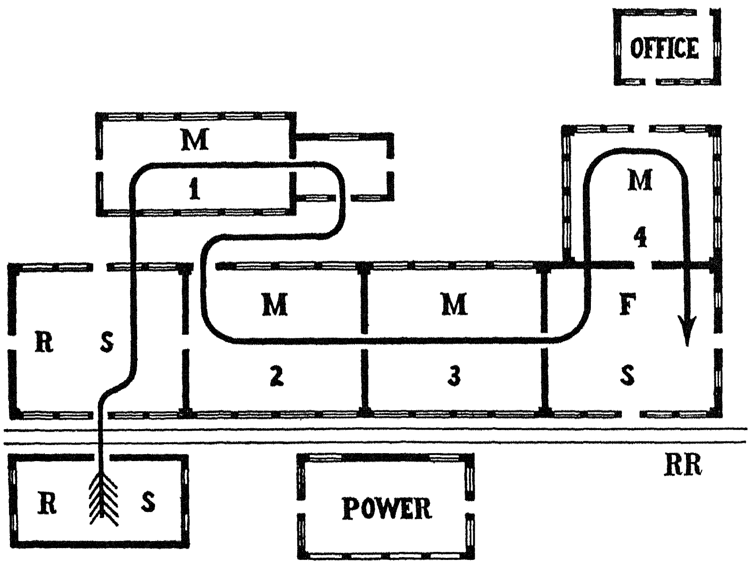


FIG 14.—ACCRETIONARY PLAN

the confusion of an accretionary factory type. Continued enlargements rapidly lower the efficiency of such a plan; while radical enlargements mean a clean sweep.

Duplicate I Plans.—An I plan may, of course, consist of several buildings

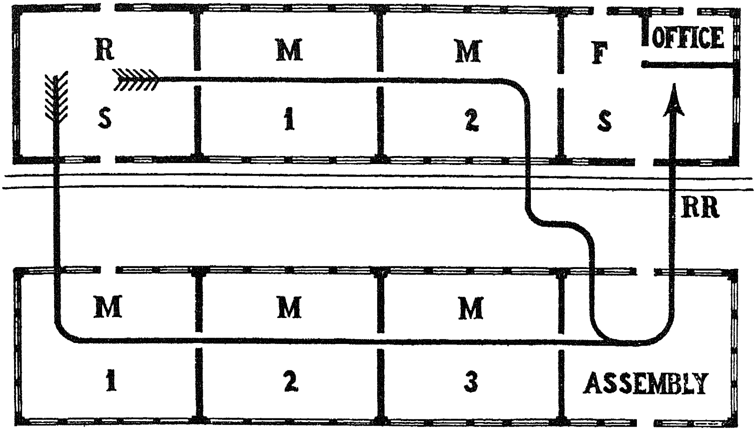


Fig 15 —Duplicate I Plan

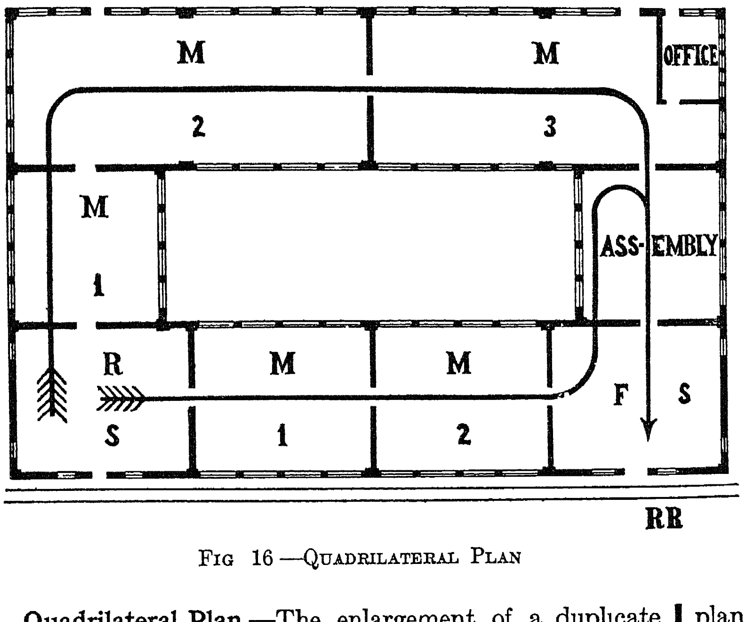


Fig 16 —Quadrilateral Plan

Quadrilateral Plan.—The enlargement of a duplicate I plan may produce a quadrilateral, when connecting structures are

thrown across between the original buildings. This plan was in favor in this country, for a few years, in the seventies and eighties. It was even made the object of original construction, because of indoor communication, and in spite of the obvious disadvantages in the way of inaccessible courts, a bad fire risk, and varying light. A modification of this idea, standing part way between the duplicate **I** and the quadrilateral plans, but without some of the disadvantages of the latter, is to employ a series of parallel main buildings, and to connect them with passageways devoted to service departments. The plant of the United

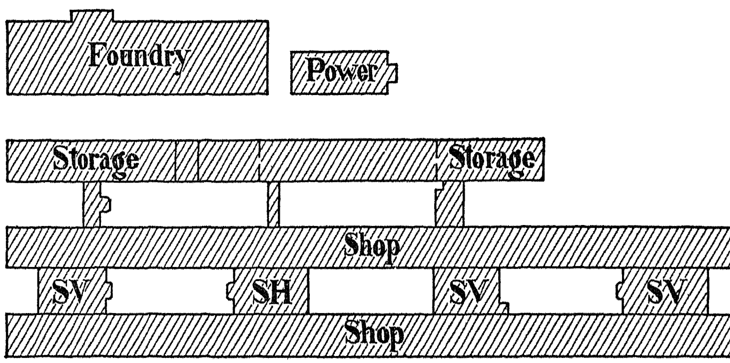


FIG 17.

Ground plan of the factory of the United Shoe Machinery Co , of Beverly, Mass , showing service centers S = Service center including locker room, wash room, tool storage and delivery room, stairway, and connecting passage between buildings V = Ventilating fans H = Emergency and first aid hospital.

Shoe Machinery Company at Beverly, Mass., has the general ground plan shown in Figure 16, which is somewhat suggestive of a quadrilateral.

The Art in Buttons plant' at Rochester, N. Y., may be called a duplicate **I** plan. It is a unit plan: and extensions will be lateral additions. A general diagram of this plant is shown in Figure 18. It has points of similarity with the Allis-Chalmers plant at West Allis, Wis., and the Worthington plant at Newark, N. J

Enlargement of Unit I and Unit U Plans.—The relation of plant extensions to various arrangements of plant departments,

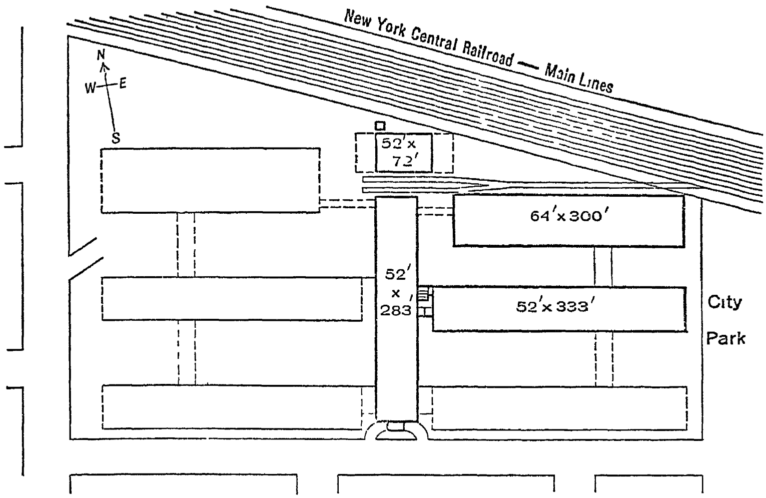


FIG 18 – DIAGRAM OF ART IN BUTTONS, ROCHESTER, N Y

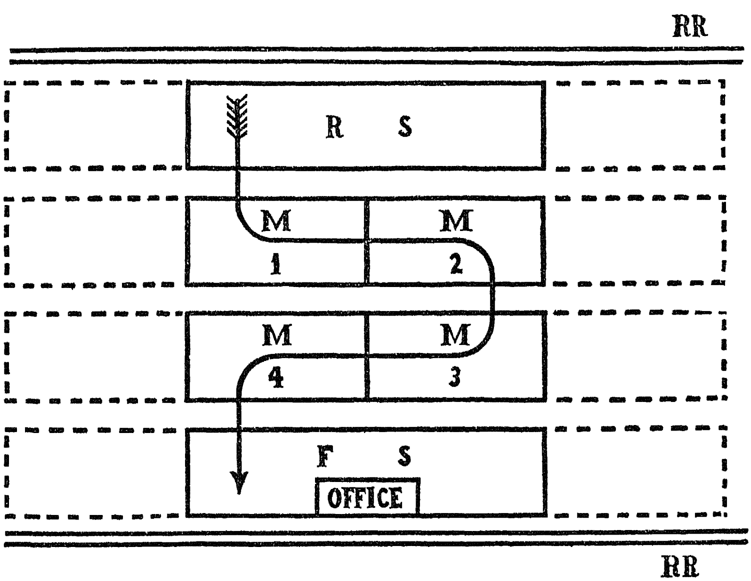


FIG 19 —THE ENLARGEMENT OF A UNIT I PLAN.

and various possible routing plans, is elaborated somewhat further in the diagrams following.

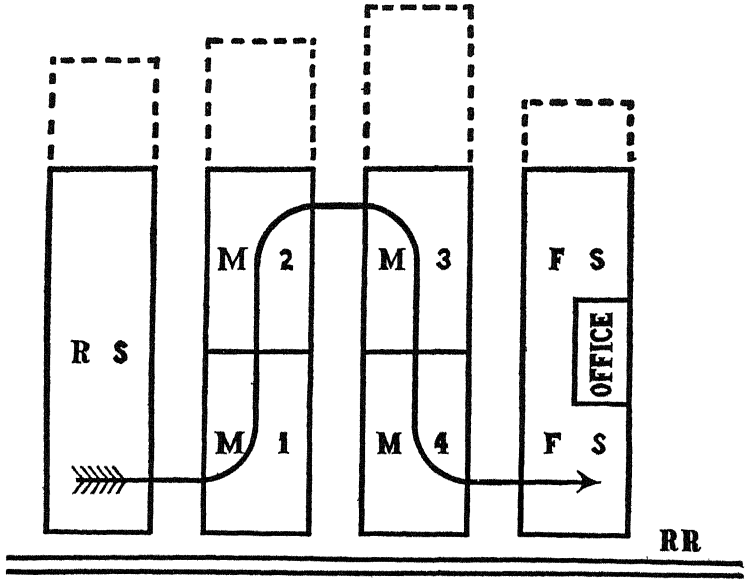


FIG 20—ARRANGEMENT PERMITTING THE PARTIAL ENLARGEMENT OF A UNIT I PLAN

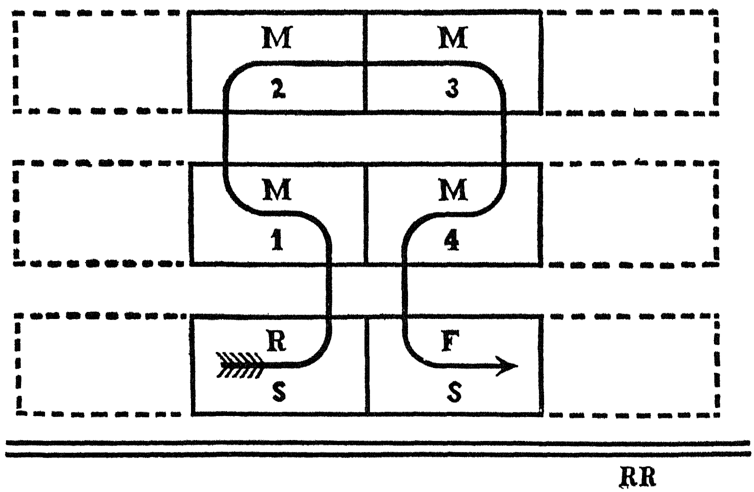


FIG. 21—THE ENLARGEMENT OF A UNIT U PLAN

When there are enough separate buildings in a plant so that each department has an entire building to itself, or one end of a building, and ground has been reserved to lengthen any of the buildings, the matter of expansion will not present great difficulties. There will be still less difficulty when the unit plan of

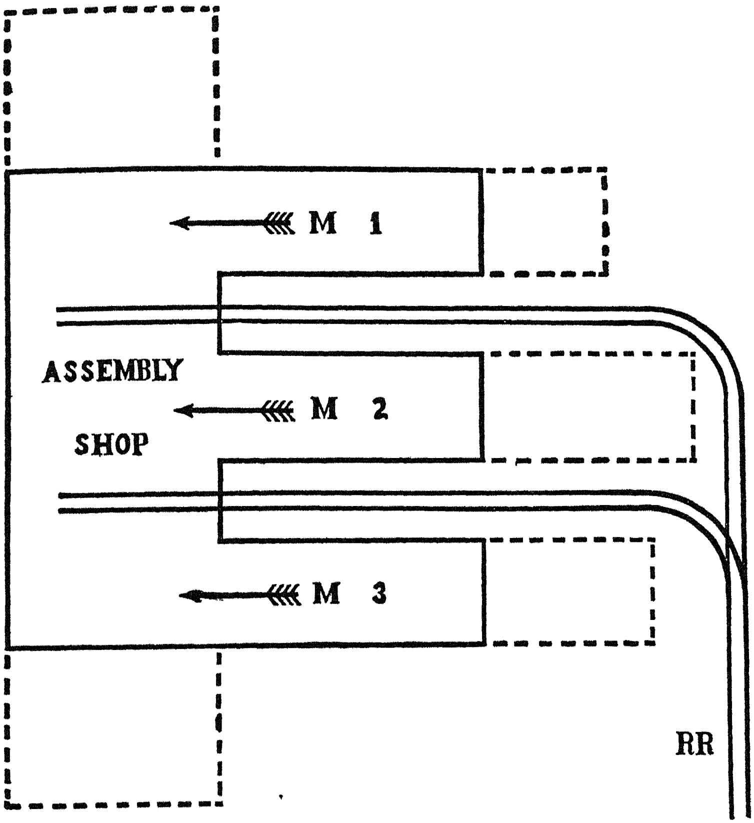


FIG 22 —THE ENLARGEMENT OF AN ASSEMBLY SHOP AND SUBSIDIARY DEPARTMENTS

construction is followed strictly, and extensions mean the construction of independent buildings, for which space has been reserved in such a way that the new buildings come into as close contact with the administrative offices, power plant, and service departments as the old buildings sustain.

Problems

The Influence of Distance and Arrangement.—Prepare for this test a board approximately $\frac{7}{8}'' \times 12'' \times 30''$ in dimension, and in it drill 100 holes of such a size that a small thick nail will slip in easily The holes should not pass through the board, but they should be deep enough to hold the nails firmly Provide a few more than 100 nails Provide also a stop watch, a clip board to hold paper, and blanks suitably ruled for making the record of a number of experiments. To make a class demonstration, a team of three students is required one to operate the peg board, one to call the time, and one to make the record Each series of demonstrations should begin with a distinctly disadvantageous layout, and proceed by gradual improvements to the best layout that can be suggested Other teams should run series of tests to check results, and also to demonstrate suggested improvements The object of these tests is to discover the significance of differences in the location and arrangement of the work elements, as shown by differences in the time required to perform a fixed quota of work

Layout of a Work Place.—Secure the permission of a local manufacturer to make a study of the layout of some one work place The study should include the making of a ground plan of all the elements involved, as well as two elevation drawings taken at an angle of 90° to each other. The work place should then be carefully written up, first, as to the location of the elements and, second, as to the work process The following matters should be included

Height of table or bench or working part of machine

Height of chair of operative, foot rests, comfort of chair, posture required or adopted by worker, characteristic arm positions and movements, standing and sitting, and characteristic wrist movements required.

Initial position of material to be worked upon

Final position of materials after being finished

Are the movements of the operative symmetrical? Is the body in balance while making major movements?

Are large movements of the trunk (as in bending or stooping) or of the whole body (as in squatting) required?

What is the weight of the material moved at any one time, and what is the approximate weight of the portions of the body which must be moved to do this work?

What inadequacies can be pointed out: and what improvements can be suggested?

Layout in Domestic Science.—A kitchen is the best known and the most widely used of work shops, yet there has been very little standardization of it, and the majority of kitchens are poorly arranged. The diagram in Figure 23 shows a poor arrangement of kitchen equipment. Rearrange

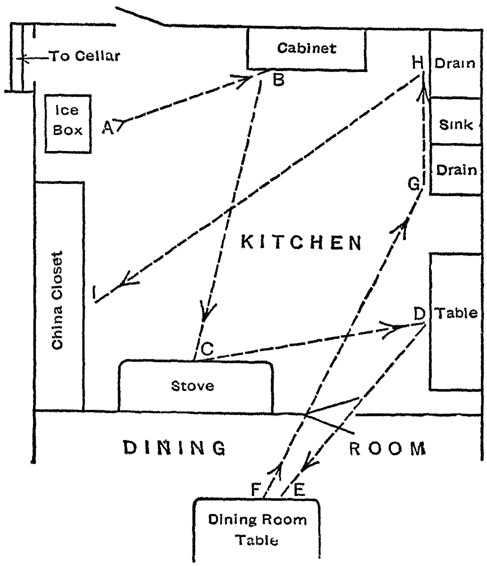


FIG. 23.—LAYOUT IN DOMESTIC SCIENCE.

the elements, without changing the position of the walls or doors, so as to produce the minimum of travel in preparing a meal, and in clearing up after one.

Layout and Motion Study in Domestic Science.—Observe and record all operations involved in getting a meal and in clearing away, in some kitchen. Study the layout and make a ground plan of present arrangement. Report with suggestions for improvement.

The Layout of a Shop.—With the permission of a local manufacturer, make a study of the layout of a single shop in a plant. Data should be secured for a drawing. The completed drawing should show

The location of spaces occupied by machines,
Any special types of mechanical equipment other than machines,
The foot spaces around the machines,
The spaces usually occupied by unfinished and finished materials,
The aisles,
The tables, work benches, etc.,

The lines of shafting overhead (in dotted lines),
The foreman's office or desk,
The location of doors, windows, stairways, elevators, pillars, etc.

On this diagram the route of the progress of material may be indicated by a heavy line, from step to step in manufacture, from the time it enters the department until it leaves it The direction of movement can be indicated by arrow heads on the line This line should be in black for those spaces across which material is moved by mechanical power, as by the operation of any machine, or its carrier attachments, or by some form of mechanical conveyor such as a belt, bucket, screw, pipe, traveling crane, shop railway, or by means of an efficient type of truck The line should be in red for those spaces across which material is moved by human power, as by handling, carrying, or dragging The report should conclude with suggestions for improving the layout In preparing this report it may be found convenient to secure a piece of beaver board cut to the dimensions of the shop floor Upon this the location and size of machines can be indicated by templates of colored cardboard, fastened with thumb tacks. The path of material movement can be indicated by colored cord held in place by tacks.

A Radial Shop Layout.—There is presented, in Figure 24, a drawing of a ground plan which was suggested by an industrial engineer, some years ago, to a group of capitalists, as a possible basis for the design of a new type of plant, to be used in the manufacture of electrical apparatus, such as generators, motors, switches, electrical instruments, etc A brief description of the layout, as given by its author, is as follows

"In the center of the space available for the buildings is located an administration building, constituting the business, accounting and sales offices, and on the second story, the drafting room. This building is octagonal or hexagonal, whichever may be found to be most suitable for the purpose. In this case it has been designed with a view to accommodating seven buildings, which radiate from each side of the octagon, and has one side reserved for the main entrance

"The end of each shop nearest to the administration building has its individual office for the foremen and shop clerks This, it will be seen, is a very harmonious arrangement, as every shop is then but a short distance from the administration building, so that intercourse can easily be had between the drawing room, the offices, and the offices of each shop.

"The general arrangement gives each shop plenty of yard room, which is very essential, and traveling cranes, either worked by hand or power, could be located in the yard between any two of the shops, for handling raw or finished material.

" A circular track around the administration building, connected in front of each shop building by means of suitable turn tables, worked by hand or power, makes the distribution of material between the buildings very easy, and it will be noticed that the distance the material will have to travel from any one building to another is comparatively short.

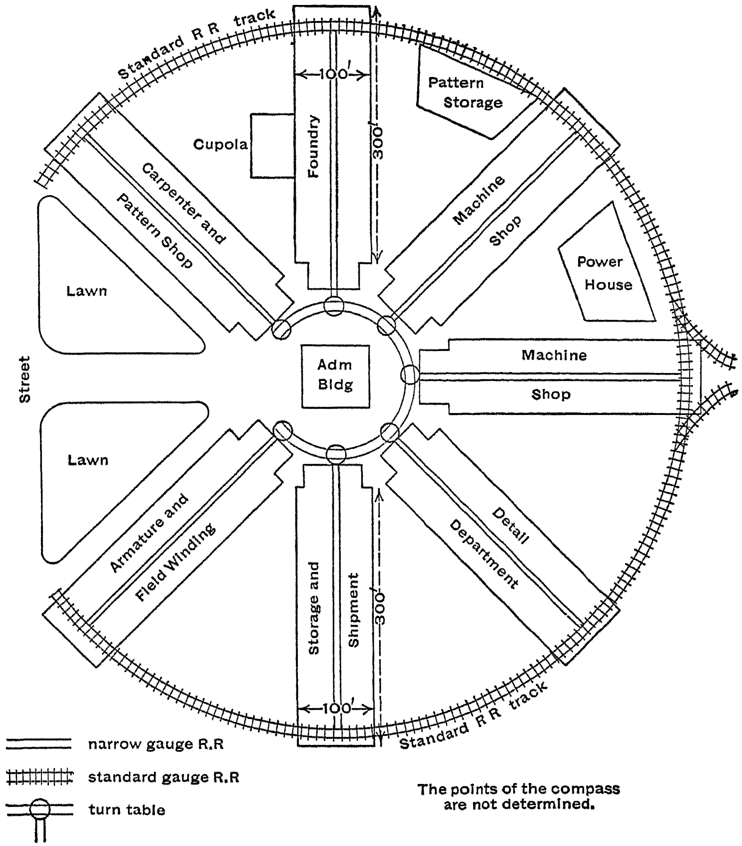


FIG 24 —A RADIAL SHOP LAYOUT.

" At the extreme outer end of each building is another circular track, primarily to be used for shipping purposes, and the distribution of such material as may come in or go out over the connecting railroad lines This track runs through the end of each building, and in each building where machinery castings or other goods are to be handled the heavier

traveling crane, which should run the length of the shop, can easily unload or load the cars This arrangement makes it possible to go into every shop without having a multiplicity of tracks and switches, thus cutting up the available yard room, as is usually the case in ordinary plants It is also possible, if there is sufficient ground available, to extend any one or all of the buildings, and still retain the best features of the design"

Study this design from every point of view, and draw up a detailed criticism of it It is suggested that you arrange the points of criticism under the following general heads 1, sequence of manufacturing processes, 2, economy in the use of grounds and buildings; 3, natural lighting of shops, 4, fire hazard, 5, location of power plant, 6, storage yards, 7, layout of standard gauge track, 8, interdepartmental communication and transportation, 9, general administration, 10, enlargement.

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CHAPTER V

BUILDINGS AND EQUIPMENTS

Functions.—The principal functions which manufacturing buildings perform are to control the conditions with reference to heat, light, humidity, and air circulation, insuring the comfort and health of workmen; and to protect mechanical equipment and materials in process of manufacture from injury by the weather. Buildings provide foundations for machines, and a rigid framework for the transmission of power. They subdivide and regulate fire risks, isolate noisy and dusty departments, multiply floor area by means of upper stories, and provide "a local habitation and a name" for each of the shops and administrative units

The General Executive and the Technical Expert.—The preparation of a set of plans and specifications for a manufacturing plant is a task which requires the working together of technical knowledge and general administrative power. It, therefore, raises the problem of the way in which general administrative officers shall adjust themselves to specialists It is easy to say that each should decide those matters for which he is best prepared by formal training or experience. The difficulty lies in the application of the rule, for in the degree that men specialize they become ignorant of each other's training and special province of action.

When a general administrator supervises work in a field with which he is not familiar, he must resort to general tests of capacity, such as the steadiness or uniformity of the expert's opinion on any given matter, the clearness of his ideas as evidenced, for example, by ability to express the gist of technical discussions in simple language, expertness in details as shown by speed and precision in handling, the soundness of such ideas as the expert may express on subjects of which the administrator happens to

be a competent judge, and unwillingness to work with methods or under conditions which would endanger success.

The object of the discussions of this chapter, and of the one following it, is to facilitate the approach of the general administrator to the field of the technical expert; it is not to encourage his encroachment into that field.

Unit Stresses.—The unit stresses to which the various floors will be subjected will determine the thickness of the walls, the cross sections of the girders and pillars, and the style of construction A well prepared layout, showing the nature and location of equipment, the delicacy of the alignment required for the machines to be used on the various floors, and the weight of materials to be carried, will assist the engineer to make proper provisions, while yet localizing expensive forms of construction.

It is better to make construction too heavy than too light. Buildings designed to carry heavy loads add very little to cost, if made of reenforced concrete; and they possess much greater saleability Heavy-duty construction is a wise precaution, even in plants intended for light manufacture, for, if some heavy machines and some heavy loads of stock are employed, it will be possible to shift their location freely, in working out a plan of rearrangement.

First Floor and Basement.—The height of the first floor is usually determined either at the ground level, or at the height of the floor of a railway car, or at a height sufficient to permit of a basement. If the site is reasonably level, it is desirable to have like floors of all buildings at exactly the same elevation above the sea level, so that, in case connecting structures are built in the future, the use of stairs or incline planes may be avoided.

If the first floor is to be several feet above the ground, a basement can be added at very little extra expense. As Mr. Geo M Brill has said, "To provide against frost it is necessary to carry foundation walls from three to five feet below the surface of the ground This depth, with the distance up to the first floor added, gives nearly the requisite height for the basement. Therefore, such space can generally be obtained for the expense of removing the soil and increasing the depth of the foundations "[1]

[1] Location, Arrangement, and Construction of Manufacturing Plants, Journ. Western Soc of Engineers, Apr , 1908, Vol 13, No 2, p. 158.

Such basements are convenient for storage and for placing wiring, shafting, and heating pipes. On basement floors the heaviest machinery can be provided with adequate foundations.

If, however, it is not necessary to lift the first floor level far above the ground, it may be said that a basement is a poor ground floor. It is poorly lighted; it entails an excavating cost, and an expense for drainage and damp-proof courses, it is an inconvenient place to move stock into and out of, and it forces all the floors above it to be a needless half run of steps higher into the air. In the days when every building had its individual heating plant, a basement was essential for furnaces. With central heating systems, this necessity disappears, and the first floor may be placed at the convenient elevation of a foot or so above the level of the ground.

Widths and Heights.—The width of a building and the height of its ceilings are dimensions which must be determined with reference to each other. Unless there is roof lighting, the greater the width of a building, the higher the windows must be to give adequate illumination in the center of the rooms. Let us assume, for illustration, that it is decided to build a structure which, in each story, will provide an inside shop, bounded by two opposite outside walls and two partition walls; and that it is desired to secure in these shops a lighting standard expressed by the ratio of one square foot of window area to each four square feet of floor space Let us further assume that on the average 75 per cent of the space of each running foot of outside wall can be devoted to windows

If we set a ceiling height of 12 ft. the window area per running foot of wall will be 9 ft. This figure multiplied by 4 gives 36 ft. as the maximum allowable distance from the wall to the middle line of the shop. Subtracting 20 per cent for dirty windows, and the interruption of belting and pillars, and there is left 28.8 ft. for a half width. Calculating in the same manner for the opposite wall, there is indicated a total building width of 57.6 ft., inside measure. Under like conditions a 14 ft. ceiling would indicate a 67.2 ft. building width, and a 16 ft. ceiling a 76.8 ft width. The tendency of good practice is constantly toward better lighting, by means of increased ceiling height, increased percentage of the wall space in glass, and buildings of less width.

Mr. Noyes argues for a greater ceiling height than the above calculations would indicate, for he has a mezzanine floor in view "In a building 50 ft. wide it is possible to get a satisfactory diffusion of light with a ceiling height of from 13 to 14 ft. A slight increase in height, however, adds very little to the cost per square foot. And the added height has certain advantages By making our ceilings 15 ft. high, we have a better light and can place in any story a mezzanine floor which will have ample head room both above and below it. Our building was designed for sufficient floor load to permit such a mezzanine at any and all points, and a grip and nut head were set in concrete for suspension for such a mezzanine at all points. There are several places in our factory where such a floor can be used. Among other advantages, it provides for expansion without rearranging the machinery on that floor. It can also be advantageously used for storage"[1]

Length.—In determining the length of a manufacturing building, the fire hazard exerts an important influence. Assuming that the width has been determined by lighting considerations, the length of a floor must not exceed such a dimension as multiplied by the width will give a total floor area within the maximum allowed by municipal building ordinances and the rules of fire underwriters' associations. The Chicago building ordinances fix the maximum floor area within fire walls at 9000 sq. ft. for ordinary construction, 12,000 sq ft. for slow-burning construction, and 30,000 sq. ft. for fireproof buildings. Using our previous illustration of a building 57 6 ft wide, this ordinance would permit lengths of 156.25, 208.33, and 520.83 ft., respectively, at which points, according to the style of construction, it would be necessary either to end the building or divide it by a fireproof partition wall.

Number of Stories.—The first thought with reference to the proper number of stories is the convenience of keeping several processes within one building, but distinct from each other. In cotton spinning a three-story arrangement is often used; one floor being used for carding, another for mule spinning of filling, and a third for the ring spinning of warp. The United Shoe Machinery Company of Beverly, Mass., decided upon four-

[1] Planning Buildings for To-morrow, Henry T. Noyes, Factory, May, June, July, 1909, pp. 48–49.

story buildings, because their service departments require as much space as the making departments. In their buildings the basements are used for storage, the first and second floors for the manufacturing departments, and the fourth floors for tool manufacture and experimental work

The lowest cost per square foot of floor space is achieved by three-story and four-story structures The reduction of cost above two stories is not considerable, however. With the addition of stories above the fourth, the square-foot cost increases rapidly, because of the necessity for better foundations, thicker walls, and more ample allowances for stairways, elevators, and fire escapes. Into the problem of fixing the number of stories enter such factors as the value of the land, the economy of heating buildings when the dimensions are approximately equal and the stiffness required in the structure to keep machinery in adjustment.

For buildings over four stories in height, passenger elevators must be provided for employees Tall buildings must be spaced well apart, to secure adequate light. If the chief source of light is over private property—rather than from a street—yard space must be set aside to protect it. Building heights are limited in most large cities according to the type of construction.

One-story Buildings.—With the exodus of manufacturing establishments from large cities in recent years, and the choice of locations in village and country neighborhoods, one-story buildings have come into frequent use. Mr. M. S. Ketchum says in behalf of them, "The best modern practice inclines toward single floor shops, with as few dividing walls and partitions as possible. The advantages of this type over multiple-story buildings are, (1) the light is better, (2) ventilation is better, (3) buildings are more easily heated, (4) foundations for machinery are cheaper, (5) machinery being set directly on the ground causes no vibrations in the building, (6) floors are cheaper, (7) workmen are more directly under the eye of the superintendent, (8) materials are more easily and cheaply handled, (9) buildings admit of indefinite extension in any direction, (10) the cost of construction is less, and (11) there is less danger from damage due to fire." [1] Where clear floor spaces of 25 ft. or over

[1] The Design of Steel Mill Buildings and Calculation of Stresses in Framed Structures, N Y, 1903, p 142.

are required, multi-storied structures are undesirable, because of the expense of supporting upper floors on long girders

Types of Construction.—Factory buildings may be divided into four classes, according to the materials employed in construction. "Ordinary frame" buildings are entirely of wood. "Slow-burning" mills are composed of brick walls and heavy wood framing. Steel frame structures may have curtain walls of brick and floors of wood, with exposed frame, or the steel may be fire-proofed with terra cotta or concrete. Reenforced concrete buildings consist of a framework of massive posts and deep slabs in which buried wires or rods serve as tension members. The floors are usually of concrete and the curtain walls of brick

Ordinary Frame.—The "ordinary frame" factory is a form of combustible architecture appropriate only for one or two-story structures, large grounds, small capital, and temporary plans. It is constructed by the use of numerous thin joist and rafters, supported by inside posts and light wall studs, the frame being thinly sheathed and roofed to keep out the weather. It is full of sharp edges of wood along which fire runs rapidly, and of spaces in which dirt can accumulate and fire make a protected advance. The stairways are usually built of light inflammable material and, in case of fire, carry the flames from floor to floor, cut off escape from the upper floors, and provide vertical shafts to improve the draft.

Slow-burning Construction.—"Slow-burning or standard mill" construction employs timber in massive sizes. It rejects all framing sticks any dimension of which is less than 6 ins; and it substitutes 2 to 3 in. roof plank and 3 to 4 in. floor plank for the thin boards used in ordinary frame buildings. The reason for this generous use of wood is that the charring action of ordinary fires seldom penetrates a solid stick more than half an inch When all the wood supports and fire stops are able to bear this deduction from their dimensions, without bringing down the building, a reasonable opportunity is given for putting a fire under control. The difference between good and bad floor construction is illustrated by Figures 25 and 26.

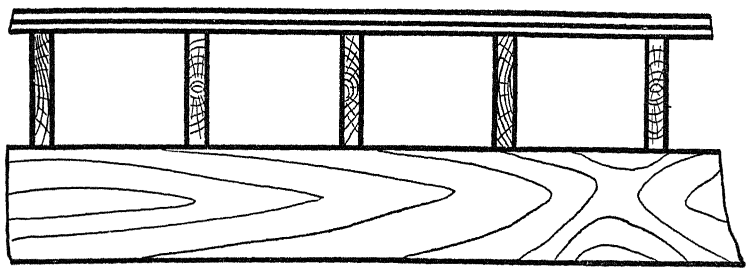
A second principle of slow-burning construction is that each floor shall be a closed fire unit. To accomplish this the floors

must extend unpierced from wall to wall, and all elevator ways and stairways must be enclosed in walls as incombustible as the floors themselves. All openings in inside walls should be equipped with self-closing fire-proof doors

A third principle is that the ceilings over all specially hazardous stock or processes shall be protected with fire-retardant materials such as asbestos board, sheet metal, or plaster on metal lath Standard mill construction will average, perhaps, one-fourth more expensive than an ordinary frame

The wooden floors of slow-burning standard mill factories

One inch sub-floor and 1 in. surface floor
Joist 2″×12″ set 16″ on centers



Main Girder

FIG 25.—UNDESIRABLE FLOOR CONSTRUCTION [1]

The timber surface exposed in a ceiling area 8 by 8 ft in dimension is approximately 26,000 sq in

are convenient for those lines of manufacture in which it will be necessary to make many openings in the floor to accommodate piping, conveyors, belts, etc. If it is desired to construct a building for heavy floor loads—150 to 200 pounds per square foot of floor space—the standard mill construction may be modified by using laminated floors. In this case the floor slabs are constructed of 2 or 3 in. plank, 6 or 8 ins. wide, set on edge, firmly nailed together, and supported by girders and posts in the usual way.

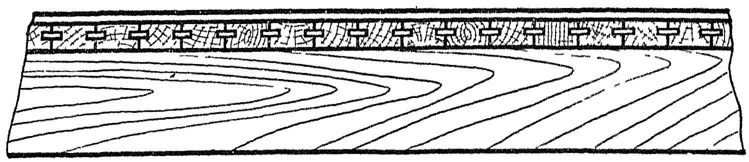
The merits of standard mill construction can be seen from the fact that the great mills of New England, almost entirely of this

[1] Insurance Engineering Experiment Station, Report No V. Slow-burning or Mill Construction, Boston, 1908

type of construction, pay the lowest insurance premiums of any class of commercial risks in this country. In a recent three-year period the fire losses were 3½ cents per $100 of insurance in force.

Steel Frame Buildings.—The chief structural members of steel buildings comprise a system of posts braced together at the junctures of floors and walls by horizontal girts, and carrying a series of braced roof trusses. Roofing materials are affixed by means of light purlins connecting the trusses. The walls are light curtains of brick, tile, or sheet metal, filling the rectangular spaces between the posts and girts With wood floors and roofs, such structures are easily destroyed by fire, as a consequence of the buckling of the exposed steel. With concrete or terra

1 in surface floor of maple
Sub-floor of 3″×5″ pine planks, grooved and splined



Main girders set 6′ to 10′ on centers

FIG 26—DESIRABLE FLOOR CONSTRUCTION [1]

The timber surface exposed in a ceiling area 8 by 8 ft in dimension is approximately 14,500 sq in

cotta floors, and fire-proofing for the steel, such structures are admirable but expensive. This form of construction has the advantage of being thoroughly understood and reliable in its engineering aspects, and of economizing space on the lower floors of many-storied buildings. The steel frame can be made to serve not only the function of carrying the building, but of supporting traveling cranes and wall machines and shafting and counter-shafting

Reenforced Concrete.—Factories built of reenforced concrete are slightly more expensive than slow-burning structures, but are materially cheaper than those of fire-proofed steel. The

[1] Insurance Engineering Experiment Station, Report, No. V, Slow-burning or Mill Construction, Boston, 1908.

advantages of concrete structures are that the floors are rigid and free from vibration, the sanitary aspects are unexcelled, maintenance charges are low, and fire hazard is reduced to the minimum. The drawbacks are that the safety of the structure is vitally dependent upon correct proportioning, a yet somewhat new field of design; and upon the mixing and pouring of materials, a process which requires close supervision. The rearrangement of shafting and machinery is difficult in concrete buildings, unless provision is made during construction for numerous points of attachment for hangers and floor bolts

Expansion and contraction constitute a problem in the case of very large structures

Fire Hazard

Significance.—The average annual fire loss in the United States, during the nine years 1915–1923 inclusive, was $375,507,994. In 1923 the total was $535,372,782; a sum which amounted to $1,466,775 per day, $61,116 per hour, or approximately $1,018 per minute Our annual losses may be pictured in the form of a street extending from Chicago to Denver, or from Chicago to New York City, lined closely on both sides with buildings, and being steadily licked up by fire at the rate of about three miles a day. At every thousand feet on this street there occurs a building from which an injured person has been rescued, at every three-quarters of a mile there is the scene of a horrible death.

Safe Construction.—The man who causes a building to be constructed assumes a serious social responsibility as the maker of a public record He turns his mind inside out before the community A miserable fire trap is a daily public demonstration to the neighborhood of the character and purposes of the owner Good practice in construction may be summarized in a series of points, those matters being omitted which have already been presented.

1. Employ a competent architect.

2 Provide more than one fire unit for all floors above the second, by constructing at least one fire-proof partition wall. The experience of factory fires shows that, where a hundred or more persons are employed on an upper floor, stairways and fire escapes, even of generous proportions, are highly dangerous.

If a panic develops, and a few fallen persons cause a blockade, the loss of life may be very great. When, however, a fire-proof partition makes it possible for persons to pass from one room to another on the same floor, the feeling of confidence that there is ample time to escape will preserve discipline, and an orderly exit will be possible. Even if a building is fire-proof, this subdivision of floors will give protection to life in this manner, as well as serve to subdivide the risk on contents.

3. Floors should have as few openings as possible, and these openings should be metal protected to prevent the passage of fire from one story to another. All openings should be finished at the floor by a boss to prevent water from passing from upper to lower floors, scuppers being provided for drainage through the outside walls at the floor level.

4. All walls and internal partitions should be either fire-proof or of slow-burning construction.

5. Interior doorways connecting fire units should be protected by automatically closing, fire-proof doors. The windows opening upon all shaft-like areas, such as light wells or small courts, or looking upon other nearby structures, or standing close to an inside angle of the same building, should be provided with metal casings and sash, and with wire-mesh glass When Mr. Thomas A. Edison lost a number of the buildings of his plant in 1914, he said: "One error revealed was not using steel window sashes and trim and wired glass that withstands great heat. We will certainly have to use that finish henceforth. My friend, Henry Ford, tells me that all his automobile factories have this steel trim and wired glass." It has been estimated that one-third of the total fire loss is caused by fire passing from one building to another, through window openings.

6. Stairways, beltways, and elevator ways should be enclosed in slow-burning or fire-proof partitions extending from the ground to the roof. In all cases where many persons are to be congregated on upper floors it is important that fire escapes should possess the two following characteristics: first, persons going down should not be obliged to pass in front of any opening of a lower floor from which flames can issue The connection at each floor should be indirect, that is to say, around a corner or along an unpierced wall. Second, if the fire escape is enclosed,

the menace of smoke should be avoided, and the draft action be broken up, by large openings to the outer air at each floor. Two fire-escape designs recommended by the Department of Labor of New Jersey are shown in Fig 27

7. If the outer covering of a roof is reasonably fire resistant a great source of loss from communicating fires is removed. Skylights and elevator pent houses are critical points in roof

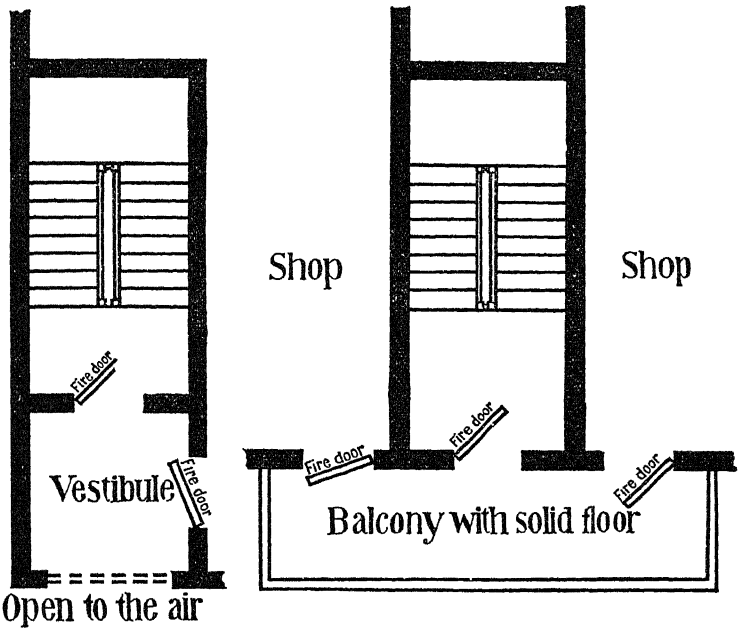


FIG 27—FIRE ESCAPES WITH INDIRECT APPROACH AND FREE AIR SPACES AT EACH FLOOR

construction because, in case of fire, they are caps closing up possible chimneys The Chicago ordinances provide that skylights must be metal protected in buildings less than 90 ft high, and fire-proof in all higher structures

8. Fires usually have small beginnings The main rule of strategy in dealing with them is to get at them early. The essential apparatus for a quick response is an automatic fire alarm, supplemented either by portable extinguishers, or stand-

pipe with hose on all floors, or by a system of automatic sprinklers, or by all three.

Automatic Sprinklers.—The automatic sprinkler installation consists of a system of pipes hung slightly below the ceilings, and so distributed that a head or valve will be centrally located over every 80 to 100 sq ft. of floor space. A fusible link in the head melts at from 155° to 160° F., and starts a water spray The pipes must be connected with a dependable water supply. It is advisable to supplement the city water by placing a tank above the roof, of sufficient capacity to operate one-half the sprinklers on any one floor for fifteen minutes. If the pipes are to be placed where water would freeze, they may be filled with air kept under pressure by a dry valve, which will admit water to the system upon the opening of any head. As the system is not intended to cope with fires which have gained headway, it is essential to extend it to every part of the risk, or to isolate the unsprinklered portions. When the valves are once opened they continue to play until the water supply is cut off, it is advisable, therefore, to add an automatic alarm to avoid excessive water damage in case the valves are opened when the building is empty

Sprinkler systems are intended especially to deal with fires which originate with the stock or contents of the building Fire-proof buildings, so called, says Mr. Bugbee, may not burn—as a stove does not burn up—but their contents will. This is illustrated by the destruction of such carefully built structures as the Equitable Building in New York in 1912, and the C. B. and Q. Building in Chicago in 1922.[1]

One of the recommendations of the Board of Fire Underwriters of New York, following the disastrous fire of the Triangle Waist Company, was that no factory building containing inflammable goods in process of manufacture, or employing in excess of a limited number of operatives, and over 60 ft. high, should be without automatic sprinklers. The General Electric Company, in 1917, had in all of its plants 250,000 automatic sprinkler heads, installed to cover 15,500,000 sq. ft. of floor space. The National Fire Protective Association has compiled the history of 8347 sprinklered fires. Of these, 7846, or 94 per cent, were put out

[1] The Fire Proof Building Fallacy, Percy Bugbee, Industrial Management, July, 1922, pp. 15–17.

by the sprinklers unaided. The failures were due to the water being turned off, insufficient water supply, concealed spaces, fires gaining headway in unsprinklered parts, etc Fifty-five per cent of these fires were extinguished by 3 valves or less, 72 per cent by 6 valves or less. These facts show the localization of water loss as compared with the general destruction incident to the work of city fire departments.

Insurance companies belonging to the National Board of Fire Underwriters grant a reduction of rates from 30 to 50 per cent for sprinklered risks, depending upon the character of the equipment For a risk of fair size, the cost of installing can be paid for in a few years out of the saving in insurance premiums; indeed, there are construction companies ready to install the system and take as their pay a part of the insurance saving.

Insurance Premiums and Building Finance.—The extra cost of fire-retarding or fire-proof construction can be entirely or largely amortized by savings in fire insurance premiums. This is true, because, for a dangerous building, the premiums are high, not only on the building, but on its contents; while for a safely constructed building the premiums on both are low. If a building is to be used as a factory, and will contain machinery and stock worth as much or more than the building, the extra cost of good construction can be paid for in from seven to fifteen years. In case a building is to be used as a store or warehouse, and will contain stock worth two or three times the value of the building, the savings will cover the extra cost in from five to eight years. In such cases, therefore, it can be said that cheap inflammable forms of construction have no standing whatever in the world of reason.

Safe Operation.—Some points of good practice in the operation of shops, to lessen fire risks, are as follows:

1 The segregation of hazardous processes, and of all but the daily requirements of such substances as gasoline, should be complete.

2 Sharp supervision should be given to wastes and oily rags and dust preventives, and to all materials containing vegetable oils which oxidize at low temperatures. Metal waste cans are now to be had which can be conveniently opened and closed by means of a foot lever.

3. The alignment of shafting, and the condition of all hangers should receive regular attention The stages of a shafting fire are, first, combustion of the oil and waste at the bearing as the result of excess friction from lack of alignment, second, the melting of the Babbitt metal of the bearing, third, the drip of this hot metal, together with burning drops of oil, to the floor; fourth, general conflagration.

4. Smoking should be prohibited during work hours and in work apartments and stock rooms.

5 The idea of a fire drill at frequent intervals should be carried from our schools to our factories If fire-fighting apparatus is installed by employers, preliminary exercise in its use is as intelligent a thing as military drill is for war, or boat drill is for Atlantic liners.

Heating and Ventilation

Inadequate heating and ventilation cause inefficiency through sickness, lowered vitality, and the inferior average of ability which results from the fact that those persons for whom employers compete actively will select comfortable surroundings.

Good Air.—Ideal heating and ventilation consists in distributing, without injurious draft, an adequate supply of air of the proper temperature and degree of humidity, and free from dust and noxious gases. The ventilation standards compiled by the Advisory Commission of the Council of National Defense, in 1918, are, in part, as follows:

A room can be properly ventilated when windows or doors or skylights are open to the extent of 5 sq ft per occupant. Failing this, 100 cu ft. of fresh air must be supplied per occupant per hour, by a positive system of ventilation, for each square foot of open window area lacking; but under mechanical ventilation not less than 600 cu. ft. should be furnished per person per hour When windows and other openings are not used for ventilation, in rooms with outside walls above ground, there is required 2100 cu. ft of fresh air per occupant per hour, by mechanical ventilation Toilets require ten complete changes of air per hour, plus 1500 cu. ft. per hour for each toilet fixture. Locker and coat rooms require six complete changes of air per

hour, plus 600 cu. ft. of fresh air per hour for each locker or suit of clothes.[1]

The emphasis in ventilation is now placed by physiologists entirely upon the temperature and humidity of the air Experiments appear to show that air is bad chiefly by reason of conditions which interfere with the proper functioning of the skin in regulating the temperature of the body.

Temperature.—A winter temperature of between 60° and 70° F., should be maintained in manufacturing departments. With vigorous exertion 60° to 65° F is not uncomfortable. But if labor is intermittent, or the quick and accurate use of the fingers is chiefly relied on, a temperature of from 65° to 70° F. is necessary. In office departments a range of from 68° to 72° F. will be used. The exact point will depend upon the humidity of the air—the less the humidity, the higher the temperature required.

Humidity.—The capacity of air to absorb moisture vapor increases with its temperature If outside air at 75 per cent humidity, and at temperatures of 10°, 20°, or 30° F. be heated to 65° F., it becomes desert-like in dryness with humidities of 8 5, 14, and 21 per cent, respectively Air of this degree of dryness sucks moisture energetically from everything with which it comes in contact. Some processes, such as textile spinning and cigar making, are impossible in such air. Upon workmen the effect is bad: the membranes of the nose and throat become parched, while the dust raised by the dryness of surrounding objects contributes to increase irritation.

Scott and Lee obtained the following results in experiments:

Temperature	Humidity	Output
69° F	52 per cent	100 per cent
75° F	70 per cent	85 per cent
91° F.	90 per cent	76 per cent

"Not only a hot and humid, but a still atmosphere is bad: the air of the working place should be reasonably cool, moderately dry, and kept in motion."[2]

[1] Requirements and Standards upon Heating and Ventilation, Council of National Defense Welfare Work Series, No 4, Washington, 1918, pp 16–17

[2] The Human Machine and Industrial Efficiency, F S Lee, N. Y , 1918, Longmans p 22

Ventilating and Heating Methods.—The ordinary system of ventilation is to depend upon the natural porosity of building materials, and to get an occasional change of air by the time-honored device of opening the windows. The ordinary method of heating shops is to attach steam pipes to the outside walls Such equipment is expensive in fuel and in the upkeep of piping, and does the job poorly. A sheet of hot air flows upward along the windows and outside walls, cooling rapidly as it passes, and finally takes its place as a bank of warm air next the roof or ceiling. Meanwhile the central and lower parts of the room remain cold. The ideal system is indirect radiation and mechanical ventilation. The apparatus required consists of an intake and fan, a battery of coils for heating or cooling, a chamber of cold water sprays or steam sprays to regulate humidity, a system of fresh air supply pipes of properly graduated dimensions and proper sized openings, together with corresponding ventilators for the outflow of used air. With such a system about one-fourth as much steam piping is required as with direct radiation, for the fan drives the air rapidly over the heating coils. The piping, also, is conveniently concentrated for repair in a basement location, where leakage can do no harm.

Artificial Illumination

It has been said that man, in the productive process, can do nothing with materials, beyond moving them from place to place where they are variously acted upon by natural forces. The sense most employed in locating things is sight. This sense, in our latitude, must be aided, for about 15 per cent of the working day, by artificial illumination. The expense of good illumination is a negligible factor in comparison with its efficiency. One of the most expensive forms of lighting is the incandescent carbon-filament lamp. The cost of operating a 16 candle-power lamp of this character is about one-half cent per hour. If a workman receiving thirty cents wages per hour is hindered one minute by defective illumination, the wage loss alone, to say nothing of fixed charges, is sufficient to provide a lamp for an hour. If a workman loses 10 per cent of his efficiency during working hours because of poor light, the wage loss would keep six lamps going during the entire day. Flexner

and Dicker have estimated the cost of one 100-watt lamp for each man, burning $3\frac{1}{2}$ hours per day, at $6 36 per year.[1] If a workman receives $1000 a year in wages, the cost of lighting is about $\frac{3}{5}$ of 1 per cent of the payroll Light is a tool which adds to the effectiveness of every other tool.

Essentials.—The essentials of an adequate system of illumination are: (1) sufficient amount, (2) proper distribution and diffusion; (3) absence of glare; (4) freedom from fluctuations, and, (5) freedom from injurious invisible radiations.

Intensity.—The light intensity required for the illumination of yards, paths, and warehouses, where men must be able to see general inequalities and large obstacles, and must have sufficient light to load and unload coarse materials, operate cranes, and handle large tools, will vary from 0 15 to 2 5 foot-candles The general illumination of machine shops should be between 1 and 2 foot-candles For the reading of blue prints and the close inspection of work in machine shops, and for desk work in offices, the intensity should be between 3 and 10 foot-candles. Drafting rooms call for from 10 to 20 foot-candles.

The Code of Lighting prepared by the Illuminating Engineering Society, and made the American Standard by the American Engineering Standards Committee, provides the approximate foot-candles in good lighting practice on the space or at the work. Some of the determinations are as follows:

$\frac{1}{20}$ to $\frac{1}{4}$ foot-candles
 Roadways and yard thoroughfares
1 to 2 foot-candles
 Storage spaces, aisles in workrooms
2 to 5 foot-candles
 Rough assembling, general lighting for boiler and engine rooms, freight and passenger elevators, rough forging, rough machine work and assembling, receiving and packing, rough stock rooms, toilet and locker rooms, rough manufacturing processes generally
5 to 10 foot-candles
 Medium fine assembling, switchboards and engines of power houses, fine forging, fine molding, rough inspecting, medium bench

[1] Good Illumination as an Accident Preventer, Proc of Illuminating Engineering Society, 1914

and machine work in machine shops, general office lighting, medium polishing and burnishing, medium and fine stock in stockrooms, medium fine manufacturing processes generally.

10 to 20 foot-candles and more

Extra fine assembling, fine inspecting, fine bench and machine work, fine buffing and polishing, drafting room, fine hand painting and finishing, extra fine manufacturing processes generally [1]

Distribution and Diffusion.—The difficulty of distribution lies in providing an intense illumination for the particular field of a man's work, while giving to the room as a whole an economical general lighting of low intensity; and yet, in doing these two things, to avoid the necessity for any individual pair of eyes making the change from one degree of illumination to another frequently or rapidly A satisfactory solution of the problem requires the careful location of small, individual, hooded lights, set close to the work, and the general illumination of the apartment by high-placed, indirect or semi-indirect lights of greater power It requires, also, such a division of labor in the shop or office as will permit each person to work in one plane of illumination, as far as possible.

"Where strictly local lighting systems are employed—that is, where individual lamps are supplied for all benches and machines—and no overhead lighting is added, the resulting contrasts in illumination will usually be found so harsh as to be objectionable even though the lamps themselves are well shielded The eyes of the workman looking up from his brightly lighted machine or bench are not adapted for vision at low illuminations, hence, if adjacent objects and aisles are only dimly lighted, he will be compelled either to grope about losing time and risking accident, or to wait until his eyes have become adapted to the low illumination. Glancing back at his work, he again loses time while his eyes adjust themselves to the increased amount of light which reaches them If long continued, this condition leads to fatigue, as well as to interference with vision, and to accidents In other words, where local lamps are employed, there should also be a system of overhead lighting which will

[1] Code of Lighting Factories, Mills, and Other Work Places, Bureau of Labor Statistics, Department of Labor, Bulletin No 331, Washington, 1923, Government Print, pp 4–6.

provide a sufficient illumination of all surrounding areas to avoid such undesirable contrasts." [1]

The control of the reflection of light from non-luminous objects in an apartment is quite as important as the proper subdivision and location of the primary light sources. The field upon which a workman's eyes are focused at any moment is but a minute fraction of the total area which must be illuminated. Economy in the use of illuminant demands, therefore, that the objects at which the workman is not looking should reasonably reflect back the light radiated to them, and thus assist in the illumination of the object on which the eyes rest. It has been said that a 20 candle-power light will give as much illumination in a room with white surfaces as 100 candle-power will give in a black room. It is good practice to paint ceilings and walls and posts a light color. By this means a diffused and soft light, very agreeable to the eyes, is produced. In ordinary factory practice, where undiffused light is furnished, it is not unusual to find the brightest surfaces many thousand times as intensely illuminated as the darkest. Human eyes cannot work properly under such conditions. The Society of Illuminating Engineers recommends that the illumination ratios in an apartment should not be over 1 to 200; and, perferably, not over 1 to 100.

Glare.—Glare has been defined as "any brightness within the field of vision of such a character as to cause discomfort, annoyance, or interference with vision, or eye fatigue" Practice is still very unintelligent with reference to this matter, and shops with naked electric light bulbs, hanging in the field of vision of operatives at work, are common. In 1919, one-third of the garment factories of New York State were found to have unshaded and glaring lights in the workrooms The failure to provide a sufficient amount of light is less frequent than the failure to secure proper diffusion of light, and to keep the range of light intensities within proper limits. The pupil of an eye which is taking in light from an intense light source cannot open widely enough to give proper definition of less brilliantly illuminated objects

A workman who has a dazzling light source or reflection in

[1] Op. cit , p 14

his field of vision, and who is vainly trying to see a moderately illuminated piece of work, may complain of insufficient light, when he is really suffering from excess of light. If the brilliant light is excluded from the eyes, the pupils dilate so that the work is seen, and the trouble disappears.

On the basis of extensive reading experiments, C. E. Ferree has shown the causes of eye fatigue:[1] (1) The bright images of unshaded electric bulbs, in the field of vision, but not directly looked at, fall upon the sensitive peripheral retina, and tend to draw the focus of the eye to them. (2) These images cause the pupils to contract beyond what is necessary for the definition of the object which is in focus. (3) The peripheral retina, adapted to relative darkness, is irritated and fatigued by such light; and spasmodic muscular contraction is caused, which greatly increases the difficulty of obtaining definition. Properly diffused illumination, such as daylight, contains no such light distractions. The field of vision is uniformly illuminated. The illumination of the retina falls off uniformly from focus to periphery, and fixation and accommodation is unstrained.

As the progress of illumination engineering causes new and increasingly intense light sources to be brought into use, the danger of glare is increasing. It has been advanced as a good general rule that no one should be exposed to the frequent view of any luminous object the brilliancy of which exceeds 4 candle-power per square inch. As the intensity of the Welsbach gas mantle is from 20 to 50 candle-power per square inch, of the Mazda incandescent lamp filament from 875 to 1000, of the enclosed direct-current arc lamp 100 to 500, and of the open arc lamp 10,000 to 50,000 candle-power, this rule can be interpreted to mean that no light sources, and no mirror-like or undiffused reflection of the direct rays from such a source, should be directly visible. Lights of small size hung near the work should always be hooded by metal reflectors, so that the light is kept out of the operative's eyes and directed to the proper area Larger lamps, intended for general illumination, should have their light diffused by globes which are dense enough so that the form of the light source

[1] Tests for the Efficiency of the Eye, C. E. Ferree, Bryn Mawr College Monographs, Vol XI, 1916, No 5, pp 52–53 Reprinted from Transactions of the Illuminating Engineering Society, Vol 8, January, 1913.

within is not revealed, but the effect is given of the light pouring from the globe as a whole.

Light and the Cost of Accident Insurance.—The American Standard Code of Lighting contains the following suggestive discussion of the economy of good light, through the saving of compensation insurance premiums "Compensation insurance premiums for a given plant are based on the amount of the pay-roll, and the rate is determined by the accident experience of a given industry, modified by the experience of the particular plant under consideration. With a rate of 1 per cent the annual premium in the case of 1000 employees at an average wage of $40 per week would be $20,800

"An insurance carrier might pay the claims resulting from two accidents per month (on an average) in this plant, and meet his own overhead costs, and still have a slight margin of profit An experience of three accidents per month, one-third of them due to poor lighting (a not unlikely event), would probably leave the insurance carrier no option but to increase the rate by, say, 50 per cent. The premium would then be $31,200—an increase of $10,400. If the lighting costs only $3 per employee or $3000 per year total, the owner's annual expense for poor illumination actually amounts to $13,400—of which $10,400 is required by the insurance company to meet accident claims An expenditure of $6 per year per employee for lamps and energy might save a large portion, if not all, of the latter amount"[1]

Building Contracts

The various forms of building contracts may be classified under four heads, with reference to the manner in which the financial relations between the owner and the contractor are determined.

1. Lump-sum contracts, or the form in common use at the present time.

2 Cost-plus-a-percentage contracts, with or without a guarantee not to exceed a stated maximum

3. Cost-plus-a-fixed-sum contracts, one modified form of which provides a theoretical cost, and establishes a sliding scale of bonuses if actual cost is less, and of penalties if it is more

[1] Op cit, p 28

Lump-sum Contracts.—Under this plan the owner provides complete drawings and specifications, on the basis of which contractors bid by naming a sum for which the work will be done. The lowest bidder secures the work, unless there is a clause employed which permits the owner to reject any or all bids.

Among the advantages of this system the following points may be mentioned:

1. It necessitates clear and complete specifications and drawings In the preparation of these the owner is likely to determine exactly what he wants before he calls for bids. The bids enable the owner to know at the start what the work will cost, so that he can promptly take the necessary steps to finance himself.

2 The contractor, likewise, knows from the moment his bid is accepted what materials and laborers will be necessary, and what his remuneration will be.

3. In the competition of bidding there is definiteness and simplicity. The plans are handed out; the bid is a single figure

The disadvantages include the following points:

1. The labor of arriving at bids is considerable. The owner must endeavor to foresee and provide for every contingency in the plans. The bidder must forecast all that might arise in the doing of the work. The labor of making such advance calculations is labor lost to bidders who fail to land the contract.

2 On work of any magnitude, such forecasts are seldom accurate. If the contract contains clauses which place much arbitrary power in the hands of the supervising architect, it is impossible for the bidder to tell what will happen. On the other hand, if changes or additions are made as work progresses, the contractor has a chance to bring in the much-dreaded bill of extras; and he has, also, an excuse for not finishing the work on time.

3 When physical uncertainties exist, such as the chance that work on footings will reveal quicksand, or tunneling work will encounter rock, a contractor may be made a bankrupt or may pocket unreasonable profits. A contractor specializes upon labor, materials, and work processes, and so is a manufacturer rather than a trader. He is usually not equipped to carry speculative risks: and he cannot make the thoroughgoing inves-

tigations which will avoid them, so long as he is a mere bidder uncertain of obtaining a contract The owner is to possess the finished work, and it seems as fair that he should pay exactly what it costs as that he should pay an average or standardized cost.

4. The greatest objection which can be made against the lump-sum contract is that it arrays the owner, with his engineer or supervising architect, squarely against the contractor, making the interests of the two as opposite as possible This antagonism prevents these persons, who usually have different kinds of knowledge and talent, from working in harmony It is this antagonism which makes loop-holes and extras dangerous, and which makes necessary elaborate specifications and rigid systems of inspection.

Cost-plus-a-percentage Contracts.—Under this plan the contractor agrees to furnish all the materials, labor, superintendence, and equipment necessary for the doing of a given piece of work This he agrees to do at cost, taking his own remuneration in the form of a percentage—10 to 15 per cent—calculated on the cost There is sometimes an arrangement that the cost is not to exceed a specified amount

The advantages may be first considered.

1 There is no dispute between the parties as to the qualities of materials or the character of the workmanship to be used, and very little as to the rate of advancement of work. The owner has his way and pays for it The contractor has no reason to withhold advice which will lower the cost for, if he earns less for the job, the lowering of cost usually means the elimination of slow kinds of work, so that his rate of earning in terms of time is increased

2 Plans may be changed as the work advances. This is convenient in cases where the specifications are poor or the drawings full of imperfections

3 Time may be saved by starting work promptly The specifications relating to later stages of the work can be prepared while the earlier classes of work are under way

4. The contractor, by being relieved of worry as to the weather, cost of materials, etc , has his mind free for the problem of doing the work in the best possible manner.

5. The owner has every motive to refrain from unreasonable demands. He is quickly educated by the cost reports he receives

Passing to the disadvantages, we find.

1. The elasticity of the plan encourages the starting of operations before plans have been well thought out, and before the cost has been reasonably counted by the owner.

2. Trouble may arise in any " cost plus " contract as to what items may properly be included as cost. If the contractor furnishes derricks and tools and wagons, what charge should be made for them? How shall the use of the contractor's buildings and storage yards and office force be charged for?

3 Contracts based on cost are obviously open to the fraud of secret rebates. If the contractor does not take these rebates for himself, he may nevertheless fail in diligence in securing them for his employers.

4. There is an idea among workmen that it is justifiable to " soldier " at an owner's expense, whereas to soldier on a contractor is to rob him of his living This idea workmen are made bold to apply, since they understand that the owner will not soon be on the market for labor again. The contractor has not the incentive to manage with energy, except as speed increases the number of jobs he can handle in a season.

5. The largest costs roll up in a given time when easy, commonplace, standardized forms of work are under way The contractor will find it little to his interest to do fine, difficult, or unusual work, which requires careful supervision, but upon which the percentage earnable per week is low.

6. The owner, who is at best an intelligent amateur, may be overstimulated, so that he attempts to dictate in matters which he does not understand A dispute as to the division of administrative authority may arise unless decisive clauses are in the contract.

Cost-plus-a-fixed-sum Contracts.—This plan provides that the owner shall pay the cost of a piece of work, and an additional fixed sum as the contractor's profit.

The plan was devised to avoid the premium on sloth which the percentage plan was thought to offer. By pushing his work through energetically, the contractor gets his reward without diminution and in a shorter time.

The defects of the plan are similar to those of the cost-plus-a-percentage plan, except for the premium on sloth.

Problems

The Economics of Building Proportions.—It is important for the student to gain a correct idea of the influence of length, width, number of stories, and total mass, of buildings upon the cost of construction. Through the courtesy of Mr Charles T. Main, construction engineer, of Boston, we are permitted to present tables of approximate present cost per square foot of floor space, for a standard brick mill building of a type similar to the well-known "Wood Mill" of the American Woolen Company, at Lawrence, Mass. The structure has pilastered brick walls with 8-in. reveals The distance from the ground to the first floor is taken at 3 ft. Buildings 25, 50, 75, 100, and 125 ft wide have stories 13, 14, 15, 16, and 16 ft in height, respectively Floor areas are figured to the outer face of pilasters Roofs project 18 ins beyond the outer face of the pilasters Inside stairways and elevator towers at each end of all mills Plumbing allowance is two fixtures to each floor of 5000 sq ft of area, one additional fixture being added for each 5000 additional square feet, or fraction thereof The surface of the ground is assumed to be level

The following problems should be solved by the use of the tables It is suggested that the problems be solved with the use of the widths provided in the tables only If lengths between those shown in the tables are required, interpolation should be made on a simple proportionate basis between the two nearest cost figures given

1 What are the dimensions which will give the lowest cost for a one-story weaving shed to contain 20,000 sq ft of floor space?

2 What would be the dimensions to give lowest costs for such a one-story shed to contain 29,000 sq ft?

3 In a proposed construction project it is desired to have only buildings of a width of 50 ft or over The floor space desired is 175,000 sq ft. Show from the tables in what various forms this area can be obtained, with the unit cost prices Indicate the minimum unit cost dimensions.

4 Arrange in order of ascending cost the various dimensions in which 67,500 sq ft of floor space could be arranged in buildings of 3 or 4 stories height

5 A building is to be 75 ft wide There is a difference of opinion among the proprietors as to what number of floors will give the lowest cost They must have 30,000 sq ft of floor area. What is the solution of their problem?

COST OF BRICK MANUFACTURING BUILDINGS IN CENTS PER SQUARE FOOT OF FLOOR SPACE—*Continued*

Five Stories

Length in Feet	Width in Feet					Length in Feet	Width in Feet				
	25	50	75	100	125		25	50	75	100	125
50	628	424	368	340	324	280	360	250	218	200	188
60	564	388	340	314	292	290	358	248	216	198	186
70	536	360	318	292	272	300	356	248	216	198	186
80	500	342	300	276	258	310	354	246	214	196	184
90	480	328	288	264	246	320	352	246	214	196	184
100	464	320	278	256	240	330	350	244	212	196	182
110	450	310	270	248	232	340	348	244	212	194	182
120	436	302	264	242	226	350	346	244	212	194	182
130	426	296	256	234	220	360	344	242	210	194	180
140	418	290	252	230	216	370	344	242	210	192	180
150	408	284	246	226	212	380	342	242	210	192	180
160	400	280	242	222	208	390	342	240	208	192	178
170	392	276	240	220	204	400	340	240	208	192	178
180	388	272	236	216	202	410	340	240	208	190	178
190	384	268	232	214	200	420	338	238	206	190	176
200	380	266	230	212	198	430	338	238	206	190	176
210	376	264	228	210	196	440	336	236	206	188	176
220	372	262	226	208	194	450	336	236	206	188	176
230	370	260	224	206	192	460	336	236	204	188	174
240	368	258	222	204	192	470	334	234	204	188	174
250	366	256	222	204	190	480	334	234	204	186	174
260	364	254	220	202	190	490	334	234	204	186	174
270	362	252	220	202	188	500	334	234	204	186	174

Six Stories

Length in Feet	Width in Feet					Length in Feet	Width in Feet				
	25	50	75	100	125		25	50	75	100	125
50	626	436	376	348	328	280	356	254	222	204	192
60	566	394	348	312	298	290	354	252	222	204	190
70	526	366	324	290	278	300	352	252	220	202	190
80	496	348	308	276	264	310	350	250	220	202	188
90	476	332	296	268	252	320	350	250	218	200	188
100	460	324	286	260	244	330	348	248	218	200	186
110	446	314	276	252	236	340	346	248	216	198	186
120	434	306	268	246	230	350	344	246	216	198	186
130	422	300	262	240	224	360	344	246	214	198	184
140	412	294	256	236	220	370	342	244	214	196	184
150	406	288	252	232	216	380	342	244	212	196	184
160	400	284	246	228	212	390	340	244	212	196	182
170	392	280	242	224	208	400	340	242	212	196	182
180	386	276	240	220	206	410	338	242	210	194	182
190	382	272	236	218	204	420	338	242	210	194	182
200	378	268	234	216	202	430	336	240	210	194	180
210	374	266	232	214	200	440	336	240	210	194	180
220	370	264	230	212	198	450	334	240	208	192	180
230	368	262	228	210	196	460	334	240	208	192	180
240	366	260	226	208	196	470	334	238	208	192	178
250	362	258	226	208	194	480	332	238	208	192	178
260	362	258	224	206	194	490	332	238	208	190	178
270	360	256	224	206	192	500	332	238	208	190	178

6 A building 75 ft wide and 4 floors in height has cost $170,040 What is its length?

7 A corporation desires to construct a single building to afford 50,000 sq ft of space An architect recommends a two-story building 75 ft. in width. The managers would like to have a one-story building 125 ft. wide, and indicate their willingness to pay 10 per cent extra to get it. The architect, however, tells them that a one-story structure will cost them at least 25 per cent extra What are the facts?

8 Considering the requirements of the proprietors in problem number five, who wish a building 75 ft wide, and must have 30,000 sq ft of floor space, what effect will it have upon the recommended building form for them if it is considered that any ground area saved will involve an economy of 4 cents per square foot (of ground, not floor) per annum in saving of such expenses as interest on investment in ground, taxes, etc., but that any sums expended in construction over and above the lowest sum which will provide the necessary space will entail a charge of 7 per cent per annum for the dividends on the stock to be issued?

9 The size of the lot on which a city factory is to be built is 100 ×350 ft. It is decided by the owners to limit the width of their building to 75 ft. and to provide 93,750 sq ft of floor space They have recommended to the architect to reserve 100 ft at the back of the lot for future growth. Assume the width and floor areas mentioned to be fixed factors Criticize the suggestion made to the architect about reserving a portion of the lot, showing the sacrifice it will involve Point out the most economical dimensions and the lowest attainable costs, with and without this restriction

10 Considering still the problem of the owners above mentioned, and basing calculations upon the cheapest form in which 93,750 sq ft. of floor area can be put, with 75 ft of width retained as a condition, what would be the extra cost of adding another floor at once, to provide room for future expansion? Deducting from this extra cost, the amount which would be saved by doing away with the reserved area in the back yard, at what final net unit cost would the extra floor area be secured? How would this compare with the cost of building an addition in the back yard at a later time to provide the same area?

Insurance Premiums and Building Finance.—Three plans for a small two-story structure, 25 ×40 ft, have been drawn up, involving different proposed styles of construction, and contractors' bids have been obtained. The results are found to be as follows:

Type A. Brick walls and slate roof, $5550.

Type B Concrete walls and tile roof, $5200.

Type C Frame structure with shingle roof, $4500.

It is found that the insurance rates per $100 per annum on building and contents will be, for different uses, as follows

Property	As Dwelling	As Store	As Factory
A. Building .	$0 495	$0 95	$1 4125
A. Contents	0 495	1 0125	1 4125
B. Building ..	0 495	0 95	1 4125
B. Contents	0 495	1 0125	1 4125
C. Building ..	0 882	2 75	2 3875
C. Contents.	0 882	2 6875	2 3875

It is assumed that the building will be insured for cost, and that if it is used as a dwelling the contents will be insured at $2500, if as a store at $6000, and if as a factory at $12,000.

Depreciation on the structures is estimated on cost annually for A at $1\frac{1}{4}$ per cent, for B at $1\frac{1}{2}$ per cent, and for C at $3\frac{1}{2}$ per cent. In addition, C structure requires $50 00 more, every fourth year, for painting, and $40 00 more every winter for heating Will these differences in depreciation, upkeep, heating, and insurance amortize the differences in first cost for Type A or B used in any of the three ways, if so, in approximately how many years? Allow interest at 6 per cent per annum compounded annually, and set up a sinking fund with interest at the same rate compounded annually. Interest and annuity tables will be found following the problems of the last chapter in the book

The Cost of Good Illumination.—It has been said, "If an operator, because of good illumination, saves—in more production or better quality of product—the equivalent of only three minutes per day for 300 days, he will offset the annual cost of the illumination "

Assume that the lamps in a shop are so spaced that one 100-watt incandescent electric lamp will take care of one operative, that the lamp burns on the average 2 hours a day for 150 days in the year, that the life of the lamp is 1300 hours, and that the operative works 8 hours a day for 280 days in the year The cost of the lamp is $1 25 An enameled reflector costs $2 50. The cost of wiring each outlet is $9 00 Allow interest on the investment at 6 per cent per annum, compounded annually, and depreciation on reflector at 15 per cent, and on the wiring at 5 per cent. Cleaning costs 5 cents per light, and is done every two weeks Electric current costs 5 cents per kilowatt-hour (per 1000 watt-hours) What is the total annual cost to maintain the illumination?

What number of days or hours must the operative save or gain at his work, if his time is worth 45 cents per hour, to equal this cost? How many minutes a day must the operative save or gain, during the period when the lamp is burning, to equal the cost of the illumination for a day?

Building Codes of Cities.—Secure the building codes of several cities, which are large enough to print their codes, and report as to the manner in which they restrict the builder of a proposed manufacturing plant. Compare the codes with each other, as to their leading provisions.

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CHAPTER VI

POWER

Relative Factors in the Power Problem.—The first requisite in a power plant is dependability: a distant second is economy. The cost of power to a manufacturer, from his private plant, may be from 1 to 5 per cent of the cost of his finished product. Placing the figure at 3 per cent, if he achieves a 10 per cent economy by means of some improvement, he has made a saving of only $\frac{3}{10}$ of 1 per cent in his costs, while a shutdown of his plant due to failure of power will almost entirely stop operations in his shops, and will make the entire overhead charge a complete loss, and (for a short stoppage) almost all of the labor charge as well. And this does not consider the possible loss of customers from delayed deliveries. Dependability must be the first thought in the installation of power equipment, and in the consideration of the question whether power should be bought from a central station or produced at the plant.

But economy is by no means negligible. To ascertain the law of economy we consider the elements of expense in operating a power plant Some of these items of expense will decline as the power used declines (although not proportionally), and will cease, or be greatly reduced, when power consumption ceases These cost items may be called functions of operation. Such items will be the outlay for coal, water, supplies, and some part of the outlay for labor. Other items of expense will continue whether the plant is shut down, is on reduced capacity, or is operating at full capacity. They may be called functions of time. Such will be the charges on account of the original investment in ground, buildings, and equipment. These are the well-known five normal elements: depreciation, maintenance, rent, interest, and taxes. Other relatively non-fluctuating charges will be the cost of supervision, and the charges for water, coal, supplies,

and labor to operate the power house on a reduced schedule, or on a stand-by basis with banked fires

Obviously, the weight of the charges which we have spoken of as functions of time, will depend upon the size and elaborateness of the power equipment. The power plant must be sufficient to take care of the maximum demand But a plant will demand much less than this maximum during most of the hours of its operation; while for the time when the plant is shut down, the demand will be nominal The ratio of power utilized (average power consumed) to power producing capacity must be, and is, very low in the case of most manufacturing establishments. This ratio is called the Load Factor When the load factor is low, say 33⅓ per cent, the power costs which are functions of operation are moderate But those which are functions of time are operating with undiminished force, and the sum of them must be divided upon a small number of power units consumed, so that the cost of such units will be high Costs will vary with the load factor. a low cost accompanying a high load factor, and a high cost accompanying a low load factor.

Something as to the nature of the fluctuation of power cost with changes in load factor may be learned from the following tabulation. The approximate cost of power per kilowatt hour, produced by isolated steam power plants of various sizes, operating 2700 hours yearly, with coal costing \$6 00 per 2000 lbs., with plant costing \$125 00 per kilowatt of capacity, has been worked out, for various load factors by W F. Uhl,[1] as follows·

Load Factor, Per Cent	500 Kw Plant	1000 Kw Plant	2000 Kw Plant
100	\$ 0155	\$ 01475	\$ 0135
75	01875	0175	01575
50	02575	0235	0215

Considering the case of the 500 kw. plant, it will be seen that a 75 per cent load factor gives a manufacturer 21 per cent higher power cost than a similar plant with 100 per cent load factor.

[1] Industrial Power Problems, W F Uhl, Trans. American Society of Mechanical Engineers, Vol 40, 1918, pp 537–552

A 50 per cent load factor means 66 per cent higher cost. Calculating percentages in the opposite direction, if a manufacturer with a 50 per cent load factor could improve his ratio to 75 per cent, he could cut his power costs 27 per cent. Starting with a 75 per cent load factor, if he could improve to 100 per cent, he could get his power for 17 per cent less.

A ratio can be altered by changing either quantity, therefore, the problem of the load factor is a double one. In one aspect it is the problem of keeping down the fixed cost elements. In another aspect it is the much wider problem of regularizing power consumption. The first of these aspects is a power problem pure and simple. How, with unfavorable load factors, can power cost be kept down? Obviously by as simple and inexpensive equipment as is consistent with reliability. This explains why many managements of intelligence have crude conditions in the power plant. With a poor power load, it may be more economical to have inefficient coal consumption than to install an engineer's dream of perfection and carry the fixed charges it would entail.

The smallest power installation which will carry a given peak load depends upon how much of an overload the units will carry from a few minutes to a couple of hours each day. Economical general results in cost mean far exceeding rated capacities for short periods, even if the pounds of water evaporated per pound of coal are lowered in so doing. With this idea of overload, boilers must be chosen, and layout designed. Coal must be chosen which can be burned rapidly. Perhaps, also, underfeed stokers will prove an aid to economy because of their capacity for intensive operation.

The second aspect of the problem of low load factor is that of bringing the average power consumption for the plant as nearly as possible up to maximum consumption. Obviously the hours a plant is not occupied during each twenty-four are a tremendous factor. Power economy is one of the points to be gained by the operation of several shifts on a continuous schedule. Considering the ordinary working day, power economy demands a very much more steady consumption of power in the shops than usually takes place The usual load chart shows a slow getting under way in the morning, a falling off before noon, a slow afternoon

start, and a falling off of work long before quitting time. This condition presents a prime administrative problem. Shut downs lower the load factor, therefore, precautions must be taken against breakdowns, strikes, and unemployment caused by lack of orders

Supervision of Operations.—The questions which arise in day-to-day administration of the operation of a power plant seem to divide themselves, more or less, into three groups. The first of these has to do with the purchase of fuel, water, and other supplies. Coal, adapted to the furnaces, and to operating conditions, as suggested above, should be bought as nearly as is practicable on the basis of its fuel value. A proper check should be kept upon the amounts received and used, the endeavor being to hold in storage only such a reserve as will insure regularity of operation.

A second group of problems centers on the power house, and has to do with the maintenance in workable condition of the installation of furnaces and boilers, together with the more or less extensive auxiliary apparatus operated with them, such as mechanical stokers, superheaters, condensers, water softeners, and mechanical draft. And there are also to watch those insidious wasters of power, the subsidiary apparatus used for producing and distributing hot water, compressed air, cold water, drinking water, humidity, refrigeration, heat, and ventilation, so likely to be poorly designed, poorly insulated, and poorly maintained.

A third group of problems is concerned with the power transmission system of shafting, pulleys, belting, wiring, piping, and electric motors, which by reason of its wide distribution through the plant, requires the most severely systematic inspection and repair

In all of this supervision the general administrator must rely very largely upon his engineers: his prime virtue in this connection must be the wisdom he displays in selecting them.

Qualities of Coal.—The heat unit, known as British thermal unit (B.T.U.), is the amount of heat required to raise one pound of water one degree in temperature—from 39° to 40° F.—at the sea level. A fair range of the thermal power of steam coals is from 12,000 to 15,500 B.T.U. per pound. The combustible element in coal is divided into volatile and fixed carbons. The

volatile carbons vary from 5 per cent in hard coals to 40 and over in soft coals, calculating on a dry coal basis. The fixed carbons range from 50 per cent in soft coals to 85 per cent in anthracite.

The market prices of coals vary approximately with the percentage of fixed carbon, for the reason that special equipment and expert handling are required to obtain good results from the volatile elements. For this reason coal users who are equipped to handle volatile fuels will usually find that the cheapest coal is the best value for them. A rich, soft coal carelessly handled means that as a quantity of fresh fuel is thrown onto the fire by the fireman, great volumes of gas will be distilled to escape unburned to the air, while volumes of smoke will pass up the chimney coating all flues and boiler surfaces with an insulating layer of soot. Coal contains varying amounts of moisture which serve to lessen its value, not only because water is not fuel, but because there is required from 10 to 15 lbs. of coal to evaporate 100 lbs. of water in a furnace. Inasmuch as the moisture element in coal may vary from day to day, and from one part of a stock pile to another, it is necessary to make comparisons of different fuels on a dry coal basis.

Ash is earthy matter of no fuel value. In commercial coals it varies from 4 to 25 per cent. A high ash content increases the expense of every operation, such as carting, stoking, slicing, drawing, and dumping. Coals high in ash burn poorly because of the obstruction offered by the inert matter. They entail extra labor in cleaning the dust from the flues. The importance of the ash depends partly upon its tendency to fuse and form a clinker which cements itself into a sheet in the lower part of the bed and shuts out the air from the burning fuel above. There are various minor constituents of coal, such as sulphur and phosphorus which, if present in large quantities, may give trouble by attacking the metal parts of the furnace and boiler.

The size of the lumps or particles of coal is important, uniformity of size being a merit. When different sizes are used together the fine particles tend to sift into the interstices between the larger lumps and make a bed so compact that air does not readily pass through. Very fine coal is difficult to handle: if a thick bed is used the draft is poor; if a thin bed is resorted to the dust sifts through the grate, or spots burn out leaving holes

in the bed through which the draft is lost. If the draft is strengthened dust is blown onto the flues and out of the chimney.

Specifications.—The scientific way of buying coal is on the basis of detailed specifications. It is as reasonable to buy coal on analysis as it is iron ore or metals or fertilizer, provided the scale of operations is large enough so that the cost of coal analyses will not be prohibitive. The central point of a coal contract is the agreement that the fuel shall be paid for on the basis of a given number of B.T.U.—say 50,000 for one cent. In important cities in the eastern part of the United States a commercial consumer may pay from 15 to 20 cents per 1,000,000 B.T.U. In order to designate the character of the fuel to be bought, a contract should contain a guaranteed approximate analysis, and limits of allowable variation. The size of the coal may be controlled by describing the screens over which and through which it should pass. Other parts of the contract will refer to dates of delivery, and to the procedure to be followed in case of nonperformance.

Effect of Transportation on Value.—There is an important influence upon the relative values exerted by the transportation expense incurred in shipping coals of different composition to the place of consumption. The difference of caloric value between two fuels remains constant whatever their price or location. The laid-down prices of two fuels tend, however, toward a parity as the freight charge increases. If, for example, two kinds of coal, one A, a good Pennsylvania coal of 14,350 B.T.U. per pound, and the other B, a high grade semi-bituminous coal of 15,500 B.T.U., sell at the mine for \$2.50 and \$2.70 per ton, respectively, the ratio of quality is $\frac{14{,}350}{15{,}500}$ or $\frac{92.6}{100}$, and the ratio of price is $\frac{2.50}{2.70}$ or $\frac{92.6}{100}$. The B.T.U. of A is 92.6 per cent of the B.T.U. of B, and the mine price of A is 92.6 per cent of the mine price of B. But if now we pay a freight of \$4.35 per ton on each coal (about the average charge from the Eastern coal fields to interior points in New England) the prices of A and B are related thus:

$$\frac{\$2.50}{2.70}+\frac{\$4\ 35}{4.35}=\frac{\$6.85}{7\ 05}=\frac{97.3}{100}.$$

The price of A coal now becomes 97.3 per cent of the price of B. But since the fuel value of A still remains but 92.6 per cent of the fuel value of B, the higher grade and the higher priced coal becomes the more economical of the two. Transportation enhances the relative worth of superior qualities of all materials.

Requirements for Combustion.—It has been said that, of the thousand million dollars paid out annually in the United States for the coal burned under boilers, from one-eighth to one-fourth could be saved, if first-class apparatus were used, and if the principles accepted by the engineering profession as controlling the efficiency of the consumption of fuel were put into practice. A furnace is a device in which the combustible elements of coal are volatilized by heat, and mixed at high temperature with a regulated supply of air, to bring about fairly complete combustion. The essential conditions for efficient combustion may be indicated broadly under seven heads.

1. Fuel should be introduced as evenly as possible, in order that the distillation of combustible gases may be uniform. In case of hand firing, small amounts of coal should be introduced frequently and spread evenly over the grates The automatic stoker accomplishes the gradual introduction of fuel, without disturbing the drafts.

2. The fuel should be of uniform size, so that the draft will be uniform through the grate at all points.

3. Air must be admitted in sufficient quantities, that is to say, in proportion to the rate of distillation of gas from the fuel.

4. Ample space must be allowed for the gases and the air to become thoroughly mixed.

5. This mixing must take place at a high temperature, if combustion is to result. A more or less enclosed combustion chamber of fire brick should be provided. The temperature of combustion of carbon is from 1600° to 1800° F. The temperature of boiler surfaces is below 400° F. It is manifest, therefore, that if any unburned gases come in contact with the shell or tubes of a boiler they will become so cooled that combustion will not take place, and they will be lost in the flue gases. The process of evolving heat in gases by combustion must be completely separated from the process of drawing the heat out of these gases into the boiler. A mixing chamber can be formed

by constructing a heat-reflecting roof over the fire bed, which will confine the fire in an oven. To be certain that combustion is completed, there should be provided a special combustion chamber to the rear of this by hanging a tile roof from the bottom tier of boiler flues. The length and direction of the travel of gas through the flues can be controlled by tile baffles. A con-

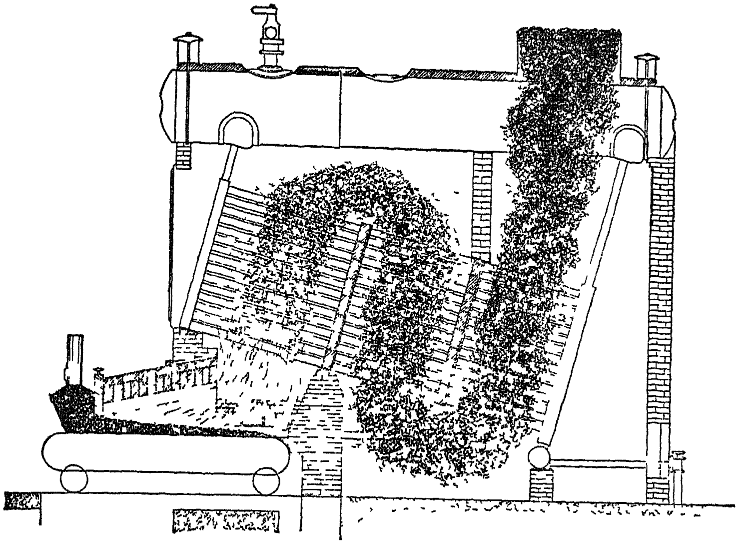

FIG 28 —IMPERFECT FURNACE DESIGN

The partly-burned particles of carbon are quenched by premature contact with the cool surfaces of the boiler, with the result of producing smoke and wasting fuel

trast between good and bad furnace design is presented in Figs. 28 and 29

By providing a mixing chamber the process of combustion is completed before the absorption of heat by the boiler is begun The result is smokeless combustion and efficient use of fuel

6. Overloads produce a less efficient process of combustion A furnace designed to burn a given amount of fuel in a stated time is in perfect balance only when doing that quantity of work They are justifiable when they enable a power plant, which would otherwise be inadequate, to carry a peak load.

7. The furnace and the fuel must be adjusted to each other. After a boiler room has been equipped, and the proper type of coal has been decided upon, there should be as little variety as possible in the fuel provided. The American Society for the Testing of Materials reported in 1909, as the most necessary reforms with reference to the use of coal: "The classification of coals with reference to fuel efficiency, the adaptation of equipment to coals for obtaining the greatest efficiency from each class

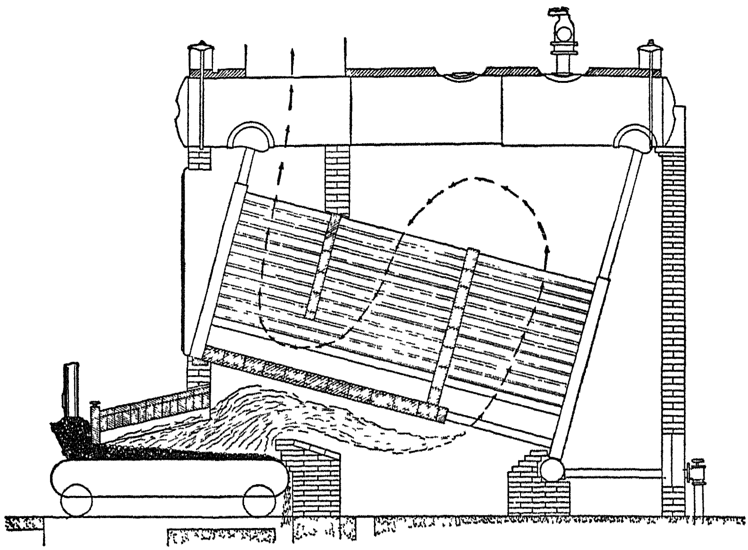

FIG 29 —GOOD FURNACE DESIGN.

of these fuels, and continued use at each plant of that type of fuel best adapted to the equipment."

Hand Firing of Furnaces.—The sprinkling or spreading system for the hand firing of furnaces consists of the even distribution of a thin charge of coal over the entire grate surface at frequent intervals. The new charge should especially repair the thin spots in the fire, the idea being to have the bed offer the same degree of resistance to the passage of air in all of its parts. A new charge should not be spread until the volatile elements have been driven off the last one, and the bed has become reduced to a porous layer of burning coke. This is the

system aimed at, but not often achieved with notable perfection, by common practice throughout the United States. Firemen should be instructed to add fuel frequently and in small amounts, so that volatile gases will not be liberated more rapidly than air can be mixed with them. A large mass of cold fuel thickens the bed, chills the fire, and diminishes the draft A fireman who pokes a fire to stimulate the burning of green fuel does not understand his job Poking is properly slicing, the object of which is to break up cakes of coke and clinker It precedes charging rather than follows it, hastening the burning of the bed down to the point where fresh fuel is called for It is bad practice to allow a fire to run up so high that severe checking is needed The sudden cutting off of air while there is evolution of gas means wasted fuel A skillful fireman will avoid the need of sudden checking by using the injector to regulate steam pressure

The Smoke Nuisance.—The Bureau of Mines has given instructions for the prevention of smoke "Visible smoke from a hand-fired furnace can be abated by effecting complete combustion in the furnace of the floating particles of carbon and tar The conditions necessary for complete combustion are as follows

1. "Sufficient air supply, which is somewhat more than the amount necessary for complete oxidation of all combustible matter.

2. "Intimate mixing of the air with the combustible gases and the floating particles of carbon and tar.

3 "Maintaining a temperature high enough for the ignition of the combustible while the combustible is mixing with the air

"Usually there is plenty of oxygen in the furnace, but it is supplied in large streams which tend to flow through the combustion space parallel with the stream of combustible or other gas carrying the particles of carbon Thus the oxygen may not come in contact with the particles of carbon and they leave the furnace and the boiler setting as visible smoke This carbon would burn if it were intimately mixed with air." [1]

Mechanical Stokers.—Stoking is a difficult art, being in reality the supervision of a complex chemical process of distilling and mixing gases. But, as a form of labor, it is attended with

[1] Hand Firing Soft Coal under Power-plant Boilers, Henry Kreisinger, Washington, 1916 Bureau of Mines Technical Paper 80, pp 54–55

so many unpleasant features that it is difficult to secure a steady force of men with sufficient intelligence to realize the possibilities of the work. Mechanical stokers may be classed as inclined grates, chain grates, and underfeed furnaces. The inclined grate will burn coking coals, for the bed is broken up by the process of shaking down the fuel from a higher to a lower level. Chain grates do not break up the bed but travel with it from front to back; coking coals cannot be used on them. But the chain grate permits a thinner fire, and so a lower grade of fuel. The speed of the grate and the thickness of the bed must be mutually adjusted. If the speed is too fast, unburned fuel will be dumped, if too slow, the rear of the grate will become bare Run-of-mine coal must be burned in a thick bed to prevent the fine particles from falling through into the ash pit. The chief claim of the underfeed grate is smokelessness and ability to carry an overload New fuel is forced in under the burning bed, so that the particles of carbon driven off by the first combustion are forced upward through the hot crown and are gasified. The fuel bed is so deep in underfeed grates that forced draft is required. The ash remains a long time in the hottest part of the fire, so that if it is of a fusible nature it melts into a solid clinker.

The points of advantage of a good mechanical stoker are economy of labor (one fireman should handle from 8 to 10 stokers), economy of fuel, ability to utilize low-grade fuel, increased efficiency of boilers, and longer life of boilers. Of the underfeed stoker, Mr. Goodenough has said, "The two great benefits given to us by the modern stoker are saving in fuel by reason of a continuously hot fire of high degree, and the ability to operate our boilers at so very much higher rating that we save on our investment. If, for instance, on a hand-fired boiler we are able to go over our peaks on 150 per cent of rating, whereas with a stoker-fired boiler we are able to go over our peaks at 300 per cent of rating, we have, theoretically, by the use of stokers, cut our boiler investment in half." [1]

This statement applies primarily to central station practice. In the small private power plant there is to consider the cost of the equipment which comes along with mechanical stokers, such

[1] The Economics of a Power Station, Walter Goodenough, Stone and Webster Journal, May, 1917, p. 347.

as coal bunkers, coal handling equipment, and ash handling equipment. A small plant with a low load factor often cannot afford to incur the additional overhead charges. The minimum-sized plant which can advantageously use mechanical stokers is probably one of 500 horsepower

Draft.—Natural draft depends upon the difference between the weight of a column of warm air in a chimney and the weight of an equal volume of cool outside air. The lower the temperature at which gases enter a chimney, the higher must the chimney be to ensure a given force of draft. Draft economy, therefore, balances the loss in hot gases over against the cost of a tall chimney. In good practice, coal should not be burned faster than 35 to 40 lbs. per square foot of grate per hour; and the gases entering the flue should not be over 500° or 600° F. With mechanical draft expensive chimneys can be avoided, at the expense of steam consumption to operate a fan Mechanical draft permits the use of low-grade fuels; it overcomes the retarding effect of an economizer; it permits overloads to be more quickly taken care of, and it permits of the regulation of draft automatically by steam pressure, and independently of temperature and barometric conditions.

In the modern furnace room, operations are controlled by means of a draft gauge supplemented, in some cases, by a CO_2 recorder, the function of which is to analyze the composition of the gases in the flue. Perfect combustion would give 20 per cent of CO_2, but since some excess air is necessary to insure the most efficient mixture with the particles of the burning fuel, a record of 15 per cent CO_2 is considered perfect. A 10 per cent mixture means 5.69 per cent fuel loss; a 5 per cent mixture a 22 79 per cent loss.[1]

Boiler Design.—The aims of boiler design are to cause the inside water and the outside gases to flow in opposite directions for the maximum travel at maximum speeds, to secure the shortest passage for steam from its place of origin to the steam chest, to prevent excessive fluctuations of pressure and, in general, to provide a simple, durable, flexible, and accessible piece of apparatus. The aim of boiler house design is to separate engines

[1] Making the Study of Combustion Profitable, Browning Robinson, Industrial Management, August, 1922, p 78.

and boilers, and secure a system of steam mains which is as short as is consistent with the ability to cut out any unit for cleaning or repairs.

Shafting Losses.—Ordinary practice in the transmission of power by belting and shafting is poor. It is calculated that losses average from 35 to 45 per cent of the power developed by the engine. These wastes result from excessive journal friction produced, (*a*) by incorrect design, as by the use of high stresses with large pulleys on heavy, slow-moving shafting; (*b*) by incorrect arrangement, as in the taking off of large amounts of power at the ends of the shafting; (*c*) by bad alignment, which means that the shaft not only rolls in its bearings but is twisted by them.

Losses may be reduced by the use of hollow shafting of small dimension, revolving at high speed, and fitted with small pulleys Alignment, in good practice, should never show a deflection of more than $\frac{1}{100}$ of an inch per foot. By the use of roller bearings as much as one-third of the shafting losses may be avoided. by the use of ball bearings, two-thirds may be avoided.

Electric Transmission.—The advantages of the use of electric power in mills and factories, with the consequent possibility of installing individual or group drive systems, have been enumerated with excellent thoroughness by Prof. F. B. Crocker,[1] as follows:

1. A real economy in the amount of power used.

2. A reduction in cost of the construction of buildings, which can be lighter, owing to the fact that there is no need to install heavy lines of shafting and pulleys.

3. A reduction in expense of service, such as oiling, depreciation, etc.

4. More efficient arrangement of machines and tools, which need no longer be placed in straight lines parallel with the shafting, but can be located exactly as desired.

5 Access to the machinery is easier from the suppression of belts and pulleys.

6. Greater cleanliness, as there is less dust and no scattering of oil or steam, etc.

7. Hygienic conditions are improved, owing to the diminu-

[1] The Electric Distribution of Power in Workshops, Journ. of Franklin Inst , Phila , Jan , 1901, Vol. 51, pp 1–7.

tion of dust and dirt, better light, owing to the absence of shafting, pulleys, etc., the lessening of noise, etc.

8. Greater ease of placing different shops in separate buildings, and in locating them according to the strict requirements of the work, and without regard to the necessities of the motive power.

9 Greater facility in the increase of establishments.

10 Localization of accidents due to motive power, with consequent less injury to individuals, and the stoppage of work only at the point where an individual motor is incapacitated

11. Greater control of the speed of the tools.

12. A marked increase in the product of any given establishment.

Individual and Group Drive.—When electric transmission is used to convey energy to motors attached to lines of shafting by which groups of machines are operated, the system is called group drive When energy is transmitted to motors attached directly to individual machines, the system is individual drive These two systems are almost always employed together, each taking its appropriate share of the load

The particular province of group drive is the propelling of a number of machines of moderate individual horsepower consumption, located compactly in a shop, and requiring to be driven at similar speeds, and with little variation of load Such situations are frequently met with in spinning, weaving, shoe manufacturing, and light manufacturing, generally. Group drive avoids the installation expense of a large number of motors, and it attains an operating economy by using a few efficient high-speed, large motors, in place of the less efficient small and slow-speed motors In individual drive, each motor must equal the maximum capacity of the machine Group drive averages out the power demands of the individual machines of the group, so that the capacity of the motor installed may be materially below,—$\frac{1}{2}$ to $\frac{1}{5}$—the sum of the maximum capacities of the individual machines.

Individual drive finds its province where large machines, such as cranes, presses, and large planers, are to be used intermittently, and with a great range of speed and load. It is also the only drive suitable for those cases, familiar in heavy engineering works, where the machine is moved to the work instead of the

work coming to the machine. The absence of shafting and pulleys makes the system essential for erecting shops where the space above the machinery must be kept clear, to permit the operation of traveling cranes This drive gives the greatest possible flexibility in shop layout, and in speed of operations Individual drive is a valuable means of relieving an overloaded group, or of accommodating a new machine, without disturbing the drive equipment already in place in the shop.

Whether to Produce or to Buy Power.—Power production is now a specialized business, under competent managements, which have invested large capital, to attain the economy of production on a large scale. So the general assumption is rapidly coming to be that a manufacturing enterprise can best stay out of this business, buying its power as it buys materials, supplies, and professional services, thus conserving its capital and managerial talent to invest in those lines of effort which are peculiar to its branch of industry.

Considering the case of a newly formed corporation, it can be said that inasmuch as the prime requirement of a power supply is reliability, the question whether to buy or to produce revolves primarily around the likelihood of interruptions to service. How likely is it that summer electrical storms will work havoc inside the station: or that winter blizzards will bring down the poles and wires? Modern central stations house the cables inside the power house, enclose the oil switches in explosion-proof chambers of reenforced concrete, isolate each important piece of electrical material, and provide spare equipment. The likelihood of line troubles depends upon whether or not feed wires are in conduits; and upon the distance separating consumer from station. Reliability is increased where more than one power source is coupled onto the distributing system; and by two sets of feeders from the stations.

The question of cost turns upon such considerations as the space available at the plant for a private power unit, and the value of this space for other purposes; upon the probable load factor; and upon the requirement of the departments for heat and live steam which, with a private plant, could be produced largely as by products.

An established business, already owning a power plant,

which is, however, becoming inadequate, will be interested in supplementary power It may purchase power to carry it over peak loads, leaving to its own plant the function of meeting average requirements: or it may purchase power for average requirements, using the old plant for peak loads and breakdowns. The situation at the plant, and the probable cost of making additions is one half of the data The other half is the manner in which the tariff of rates for central station power is constructed, with reference to the quantity, continuity, and variability of the power demand.

The price of purchased electrical energy per kilowatt-hour is probably in general about equal to the cost of production in well-managed private plants of fair size The trend toward central station power is unmistakable. In the five years from 1914 to 1919, the power in industrial establishments increased 9,964,000 horse power. Of this increase 9,347,000 horse power was supplied by central stations· only 617,000 came from all other sources Central station systems now furnish nearly one half of the power used in manufacturing The lower the price of coal the greater the cost advantage enjoyed by the private plant The reason for this is that when the cost of coal is low, the price of power delivered from a central station is strongly influenced by the charges which have to be added for the use of the poles, wires, and meters of the distributive system, and the services of accounting, meter reading, etc. When the cost of coal is high, these distributive and incidental expenses decline relatively, and the fuel item becomes important enough so that the superior efficiency of the large power plant is able to exert a palpable effect upon the price The load factors of the private plant and of the central station exert an effect upon relative costs. When the average load of a central power station is low in comparison with its maximum load, the company is apt to offer attractive prices to consumers for electricity to be used at hours other than those of maximum load. If the consuming plant has a low load factor, the cost of producing its own power will be high. The most advantageous condition for buying power exists, of course, when the purchaser wants the most power during the hours or the months when the central station has the greatest surplus capacity for sale.

Problems

Working Conditions of the Fireman.—With the permission of a local manufacturer, make a study of the working conditions of the fireman's job. Consider layout, the convenience or inconvenience of the equipment provided, state of ventilation, illumination, means taken to control temperatures and the temperature conditions existing, washing facilities, seats, etc , etc. Couple with the report suggestions as to possible improvements.

Effect of Transportation on Relative Value of Fuels.—Two coals, one "A," having an average of 13,442 B T U. per pound, and the other, "B," having 14,500 B T.U. per pound, are offered to a plant by a mining company at the price of $2 10 and $2 50 per ton of 2000 lbs , respectively. The freight to the mill from the mine is $3 00 per ton for either coal. Considering the laid-down prices of the two fuels which is the better coal to buy, considering the cost of the B.T.U. in the coal only? This situation having been established, the railways increase the freight rates by $1 00 per ton What influence will this have upon the desirability of the two fuels?

Cost of Heating.—A manufacturing company in Detroit, using central station electricity entirely for power, require to run the heating system of the building a total of 475 tons of coal, for each winter, six months—November to April, inclusive—to heat 750,000 cu ft of shop space to a temperature of 65° F. The boiler, piping, and auxiliaries cost $3500, and are estimated to have an effective life of 15 years, at which time they will have a scrap value of 10 per cent. The furnace building and stack cost $5500, and are estimated to be good for 40 years, at which time they will have a scrap value of 5 per cent. Six per cent interest on investment and a proper sum for amortizing depreciation should be charged for the use of the plant The amount which must be paid semi-annually into a sinking fund to amortize $1 00 in 15 years, if interest is allowed at 5 per cent per annum, compounded semi-annually on the payments in the fund, is $0 02278. Likewise the amount required to amortize $1 00 in 50 years is $0 00231. Other expenses for heating are coal at $6 25 a ton, one fireman (winter wages only) at $30 00 a week, and supplies and repairs amounting to an average of $225 annually. What is the average daily cost of heat?

The Power Plant and the General Layout.—With the permission of several local manufacturers who have private power plants, take the necessary measurements to construct large-scale ground-plan drawings to approximate scale Show the location of railway tracks, coal storage, boilers, engines, and the power-consuming shops. Indicate the exact

nature of the connection between prime mover and the shafting or drives of the shops. By the comparison of different layouts, appraise the situation at each plant, and make such suggestions as to possible improvement in fire risk, convenience, heat losses, or power losses, as you can.

The Geography of Central Station Service.—If data can be secured from a local power company, make a large-scale map of the territory covered by its system of wires of sufficient capacity to serve a manufacturing corporation. Indicate the position of the lines, show the zones of territory which can be served by direct connection, and indicate the zones which can be reached at designated different costs for the original connection.

Central Station versus Private Power Plant.—Make a census of power users of your locality (above a determined minimum size), showing which establishments produce their own power entirely (except for the lighting load), which depend entirely upon central station power, which use central station power entirely, but maintain a private power plant for standby, and which fall into various types of intermediate relation combining private production and central station patronage. Analyze and group the data. It may be well to prepare a map showing establishments with different power policies in different colors.

The Rate Schedules of Power Companies.—What are the principles upon which the rate schedules of large power-producing companies are based, in so far as power in considerable quantity for large manufacturing corporations is concerned? Consult Walter N. Polakov: Mastering Power Production, N. Y., 1921, Eng. Mag. Pub. Co., pp. 415–420 and Richard H. Lansburgh, Industrial Management, N. Y., 1923. Wiley. Ch. 13, pp. 156–170. Illustrate the use of the principles by illustrations drawn from several rate schedules procured from large power-producing public utility corporations.

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CHAPTER VII

THE ADMINISTRATIVE ORGANIZATION

For a full generation the United States has been the most favored spot in the world for the evolution of industrial organizations. Among the permissive conditions have been, ample supplies of raw materials and capital, freedom from military service and heavy taxation, and the existence of the largest domestic market extant. The impulse to seize the rich financial prizes offered by so great an opportunity has been supplied by the prevailing spirit of enterprise and adventure, the prominence of success in industry and commerce as a test of ability, and the dramatic character of the great movements of modern private industry.

There has been an unparalleled growth of great institutions. These institutions have so elaborated each part, and so differentiated and unfolded each function and aspect of industry, that considerations having to do with methods and policies which, in small industry, are inconspicuous details have, by reason of the mass of values involved, become matters of moment.

Administrative Responsibilities.—Like the leaders of armies in war, the executive heads of great businesses must marshal the labors and thoughts of an army of men. They supervise expenditures on a scale which would have financed ancient wars. They must design and operate a specialized equipment, devise a system of accounts, map areas, plan sequences, control pace, direct routing, and supervise processes. They must select persons, divide labors, measure tasks, apportion rewards, gather and distribute information, and solve with tact and fairness an infinite variety of employment and personnel problems. They must command storage, utilize transportation, set prices, scrutinize credits, direct publicity, and energize salesmanship in distributing campaigns addressed to the most complex of markets. They must

raise funds, market securities, account for values, watch costs, meet liabilities, pay dividends, and stand answerable to public opinion.

The responsibilities of management have been thus listed by an eminent committee of engineers and industrial executives:

"1. To establish sound business policies.

"2. To finance the enterprise.

"3. To control the expenditure of funds.

"4. To develop an organization whose functions are logically assigned to competent individuals.

"5. To design, test, improve, and warrant a product which is to be distributed in relation to demand and competition.

"6. To build or secure plant and equipment and utilize them economically and effectively.

"7. To procure adequate supplies of proper materials.

"8. To maintain a suitable supply of labor and supervise and coordinate its effect.

"9. To organize and sustain proper relationships between owners and workers.

"10 To formulate procedure based upon practicable and economical methods.

"11. To manufacture and sell at a profit." [1]

The evolution of business has compelled the formulation of principles, and the invention of administrative mechanisms, to aid proprietors in the task of management.

The Administrative Pyramid.—An administrative structure does not exist as an end in itself. The framework is to facilitate action: it is a tool of action or a prescribed channel to control the flow of force. Administrative action is not an end in itself. It is a means for the creation of goods and services. All agencies of organization, and all modes of administrative action, come to final test as servants of production. Value can be imputed to them only as a reflection from improved final results, or economy of human wear and tear in the process of producing results. Into an organization the officers and the rank and file must be fitted carefully in terms of human nature. As human nature is

[1] Waste in Industry Report of Committee on Elimination of Waste in Industry, of the Federated American Engineering Societies, N Y. McGraw-Hill, 1921, p. 392.

not a highly reasoning form of existence, this does not mean an icily logical nor a symmetrically perfect system, but rather one which is simple and flexible and easily understood, which is suited to the personalities involved, which is in scale with the enterprise, and which is provocative of those activities which are essential to success. The aim of an administrative organization is to establish such a series of relationships between the individuals involved in an enterprise that joint action without conflict is possible in the accomplishment of a common task. There must be an organization of thought in order that there may be an organization of will.

For any industrial enterprise, there is a sum total of functions to be performed: and there rests somewhere an adequate source of authority to give the necessary privilege or right to accomplish these functions. Orders issue by virtue of authority. The recipients of orders are invested with responsibility. Authority and responsibility should be equal. they are two viewpoints from which to consider duty.

Authority in the hands of stockholders is exercised in formal and infrequent rulings of a legislative nature. In the hands of directors and chief officers, this power is so concentrated under a few wills that it becomes mobile and flexible. But it is still "general" authority. For the most part it must confine itself to shaping general projects and evaluating general results. By reason of the limited knowledge and strength of the chief executives, their direct control can descend into details in exceptional cases only. To permit authority to be applied in sufficient detail to control the ultimate acts of production, it is necessary to create rank upon rank, subdividing and specializing functions connected with management. At each step downward from general toward special, a larger personnel is required than was necessary in the station above

The principle of the division of labor applies as much to administration as to execution. In work of a humble order, the assignment of functions will depend much upon the mass of work to be accomplished, or upon the spatial relations of processes in shops, buildings, and plants. In intermediate ranks, the union of functions will have more regard to natural interdependencies, the divisions between authorities following the

lines of natural cleavage in the character of the work. In the manning of the highest positions, the native talents of individuals, the customary integration of bodies of technical knowledge, and the traditional lines of demarcation in professional training, will exert an influence.

"There is a tendency," says John H. Williams, "to assign work to individuals because of the circumstance of their availability, their reputation, or personal relations. However easy and agreeable this may be to the chief, it is detrimental to the organization itself. While it goes without saying that the one to whom an assignment is made must be available and have the necessary capacity for the matter in hand, it is in most cases even more important that he should be the person charged with responsibility in such other matters as need to be coordinated with the one in question."[1]

The ratios between superior and subordinate may range from 1 : 5 to 1 : 25. Foremen may have from 10 to 25 men under them, and so have ratios which are similar to those existing between teachers and students in American universities. In higher executive positions, where each subordinate signifies a distinctive domain of activity to be supervised, the ratio of superior to subordinate will be less, perhaps, ideally, about 1 : 5. The President of the Western Electric Company in 1922 had 8 or 9 executives reporting to him, and found the number too large, so that he was carrying through a reorganization to bring the number down to 4 or 5. President Henry P. Kendall of the Lewis Manufacturing Company, a leading exponent of scientific management, considers a ratio of 1 : 4 or 1 : 5 to be sufficient. President Howard Coonley of the Walworth Manufacturing Company has a ratio of 1 : 6. He says: "We arrived at an organization showing three line vice-presidents—one in charge of production, one in charge of sales and a third in charge of all administrative functions. And since our business has many technical aspects, a fourth vice-president in staff capacity heads up all functions pertaining to engineering. There are also, of course, the other usual corporation officers—secretary and

[1] John H. Williams of Day and Zimmerman, Inc., Engineers. Bulletin of the Taylor Society, April, 1923, Vol 8, pp 53–58. Republished in Daniel Bloomfield, The Modern Executive, N. Y. Wilson, 1924, pp. 72–73

treasurer Therefore, six officers in contact with the president's office assume control of all branches of the business, each being given full authority in the direction of activities within his control, and being held responsible for financial results "[1]

By various ratios, therefore, the administrative personnel will broaden out as it departs from headquarters The administrative structure can be likened to a pyramid, each human course broader in numbers than the one above it. It is a hierarchy, in which each person is fixed in his place by bonds of duty to superior and subordinate

The Lines of Authority.—There will exist, in an intelligent organization, an unbroken line of authority from headquarters down to the persons ultimately responsible for each act And an equally unbroken line of responsibility will extend upwards, in the reverse direction The exact nature of the authority to do, or the responsibility for doing, must be defined for each person or position, or for each class of persons or positions, by means of appropriate definitions No duties should regularly devolve from headquarters upon subordinates, except in accordance with a definite assignment Every function, intended to be exercised, should be recognized in the administrative structure by being included within the boundaries of some explicit delegation of authority.

Identical authority or responsibility should not rest upon two or more persons· that is to say, the same duty should not be assigned twice And no one should be compelled to serve two masters in the same relation of answerability. Different degrees of administrative control, from direction in detail in the shop to general supervision at headquarters are, of course, distinct functions Undue concentration of duty at any point is to be avoided, an equal ratio of task to capacity throughout an organization being the ideal All individuals should be made acquainted with their duties and their administrative relations to others with whom they come in contact

An administrative relation having been established between

[1] The Control of an Industry in the Business Cycle Howard Coonley, Harvard Business Review, July, 1923, Vol 1, No 4 Also in Scientific Management Since Taylor E E. Hunt, Editor, N Y, 1924 McGraw-Hill, p 143

two persons with reference to a particular duty, should not be lightly disturbed. If there is a series of officers arranged in ascending and descending order of authority, orders should, under normal conditions, be transmitted step by step, without the omission of intervening authorities, along prescribed lines, from superior to subordinate, until the individual from whom ultimate performance is expected is reached. In a similar manner reports should proceed, step by step, in the reverse direction. The responsibility created by any authorization should be answered for to the officer from whom the authorization came. If a superior officer, in the absence of a justifying emergency, makes a short cut down the official line, and deals directly with a subordinate, who is regularly answerable to an intermediate officer, the proper administrative contacts of every person affected are thrown into doubt, and the eliminated intermediate officers have suffered a slight, and perhaps a humiliation.

Major James A Moss thus puts the United States Army rule: "After a subordinate has been placed in charge of a certain duty, all instructions pertaining thereto should be given through him, and all meddling and interfering should be avoided. Interference by superiors relieves the subordinate of responsibility, and causes him to lose interest, become indifferent, and do no more than he is obliged to do" [1]

Proper consideration for the stability of the established system need not interfere with the bringing of subordinates into conferences between superiors, to elucidate what has been done, or supply details as to a situation; but the rule does mean that when conferences conclude, and orders are issued, these orders should pass through the regular channels. Even the latitude of conferences has not always been permitted in military organizations The Duke of Wellington said that, in the Peninsular Campaign, if a higher officer so much as spoke to a private he would have been reprimanded.

A Book of Standard Administrative Practice.—If an organization has never prepared a full statement in writing of its functions, with a record of the officers to whom they have been assigned, and so has never had a comprehensive view of the relationships

[1] Officer's Manual, Maj James A Moss, 5th Edition, Menasha, Wis Geo Banta Pub Co, 1917, pp 245–247

of functions and persons, it will be profitable to prepare it. Functions may first be listed in major groups, each group being then analyzed into its elements. The next step will be to indicate the assignment of functions to officers, both with reference to immediate control and general supervision The first tabulation may appear somewhat as follows

FUNCTION	DIRECTION OF	SUPERVISION OF
Purchase of special machinery	General Manager	Advisory Committee
Purchase of materials and supplies	Purchasing Agent	Business Manager
Checking of invoices with materials received	Receiving Clerk	Works Manager
Fire protection	Works Manager	General Manager
Compilation of sales prices	Sales Manager	Business Manager
Collections up to point of suit	Credit Manager	Business Manager
All filing	Head Stenographer	Business Manager

The functions assigned to each individual can next be assembled A form like that on page 154 may be of assistance.

The duties of each administrative position can now be written out in full From the material a graphic chart of official positions can be made, and also a chart of functions. These will make clear any vagueness, duplication, undue subdivision, or crossed and confused lines of responsibility The value of such an analysis lies, first, in the many errors which can be detected and corrected, second, in the guidance offered for all future general orders and standing rules

Mr James M. Dodge, President of the Link-Belt Engineering Company, thus described the results of the compilation of a book of standard administrative practice, for his company. "I was humored to the extent that a chart was prepared We then employed less than 300 men, and it took eight weeks to make a chart of what we were doing in our shop. When we got the chart done, we went over it carefully and succeeded in cutting out $3600 of unnecessary expense in the first hour of our work The reason we were able to make this cut was that the chart show

Name	Title
Under supervision of	
Under direction of	
Duties	
1	6
2	7
3	8
4	9
5	10

Appoint and discharge:

With the approval of...

With reference to the following duties

1 } Consult with {
2
3
4
5

Reports to.

Special reports on: } to {

And as ordered by

FORM FOR FUNCTIONS ASSIGNED TO EACH INDIVIDUAL

us where the lines of our system were crossing and indicated clearly how improvements could be made, but it was beyond the power of any intellect we had in our place to see through the tangle until we had it down on a piece of paper We detected at once several instances of duplication. From that time to this we never made a change in our shop system without consulting the chart and noting it thereon, and tracing out the possible conflict that might arise. It is a mutilated document now, but it clearly shows the history of the development, modification, and improvement of the system as originally put in practice."[1]

[1] Transactions of the American Society of Mechanical Engineers, N Y, 1902, Vol. 23, p 371

With a proper organization the work of the executive is very much simplified. He can run his business through the business That is to say, the process of control will function within the very substance of the operative structure, and not merely play over its surface. The data for control will come as a by-product of normal functioning, and will not be merely the result of the energy of the executive in making independent investigations.

Balance in Development.—The resources of an organization—its buildings, personnel, cash, invoices, etc—will naturally be spread over its field of operations according to the nature and requirements of each function, up to the point which expresses in each case the conception of the management as to the importance of the function, as compared with the others. To use an economic phrase, doses of capital will be applied in each direction until an equal marginal productivity is reached throughout. The last doses of labor force, or executive attention, or invested capital applied to the various functions of an enterprise should bring in substantially equivalent profitable returns As this ideal is approached, it may be said that "balance of plant" is achieved for the organization as a whole

Such a condition satisfies the rule that analogous qualities of the factors of production should be united This is the rule referred to in the Bible illustration. "No man putteth a piece of undressed cloth upon an old garment. for that which should fill it up taketh from the garment, and a worse rent is made. Neither do men put new wine into old wine-skins: else the skins burst, and the wine be spilled, and the skins perish but they put new wine into fresh wine-skins, and both are preserved."[1]

To take a more modern illustration, it can be said that, to attain excellent performance in a train schedule, there must be skillful engineers, good rolling stock, a prompt and efficient dispatching office, and the block system of signal control. But there are also necessary heavy rails, strong bridges, and close track inspection. A number of factors must be brought to a like standard; a deficiency in any one will cut down the usability of all the others. Each factor must be able to perform as much of its kind of work as the full functioning of the other factors will render necessary Another way of putting the point is that the

[1] Matthew, 9 16–17

degree of importance of a project should be the measure of the excellence of the agencies designed to effect it; and not only of the excellence of them as a whole, but of each one of them separately.

The Prime Points of an Organization.—To the individual in an organization, whether he be an executive, a clerk, an artisan, or a laborer, the prime points of his contact are: the authority, the orders, the task, the accomplishment, the reward, and the co-workers. In watchful relation to these things each puts forth his energy.

By the **authority** is meant, primarily, one's immediate boss, who largely personifies the management. But in the more or less dim background stand all the officers, but especially such as connect the boss with headquarters.

Orders invest the individual with authority to proceed with his work: and they more or less completely or incompletely supply him with the information he ought to have. Executives usually act under the authority of permanent written rules or standing orders. More informally they act by force of unwritten custom. Operatives perform individual tasks on the strength of specific written or verbal orders, which may expire when the unit of work is completed.

The **task** will be seen in a double light; primarily, in comparison with the tasks of other workers with whom one compares himself, secondarily, in the light in which the management sets it forth

By **accomplishment** we mean to signify the valuation of the completed task, not only through the judgment passed on the work by the boss, with some mechanism of inspection, report, and rating, but in the judgment of the workman, as he considers the task as a test of himself. The management will make review more or less frequently according to the degree in which work divides itself into natural units, more or less accurately according to the employment or non-employment of standards of speed, quality, economy, etc , and with more or less of permanent record of individual or group scores.

The **reward,** or incentive, should lie, first of all in the accomplishment. Too large a part of it, unfortunately, will be pay in dollars and cents. And there may be promotion, publicity

of records, considerate treatment, criticisms and slights, undesirable transfers, layoffs, or discharge.

The **co-workers** in the shop or department will constitute an important factor, especially through the group opinion which they control. This opinion makes the temperature, or the spirit of the shop, and so it largely determines the attitude of the individual toward all the other prime points of his organization. Co-workers are not only an independent tribunal of judgment: they are an audience intensifying all experience.

A Steady Framework of Ideas.—One of the most important objectives which can occupy the thought of a high executive is that of creating a logical and permanent structure of administrative relations for the use of himself and his subordinates The successful executive constructs an edifice of ideas, by means of the general rules and the standing orders which he promulgates. And he builds additions to it, or makes alterations in it, by his explanations of the rules, and his decisions of cases arising under them Into this edifice all should be able to enter with understanding Its plan should be such that everyone can learn, without great difficulty, what is expected of him. The structure should be workmanly enough and permanent enough so that all can work in it with peace of mind

Having once brought the fundamental law of an organization into existence, the executive should use every effort to hold it constant and dependable, so that those who work under it may become familiar with it, and so that custom and habit will make its control easy and natural Such clearness, steadiness, and firmness comes only from a consistent mind. It sounds easy to be consistent: but it is, in fact, difficult. To achieve clearness at all times costs effort. To achieve consistency through a long chain of decisions requires self-discipline of a high order This will be realized if one considers the turmoil of many households with servants or with children, where the rules of the game are perpetually under acrimonious debate, and where inconsistencies are made the most of by appeal from one to the other. A good executive is like a good mistress or a good mother, capable of ruling by means of a few brief clear orders which harmonize with one another, and which remain unfluctuating from day to day.

Some executives have not the reasoning power to formulate

the general principles which underlie specific cases. Others have not the courage to be clear in the assumption of responsibility Some avoid clearness because they confound the full exercise of authority with harshness or a strictness destructive of the initiative of the subordinate. A few use vagueness as a means of slipping in additional demands secretly. Others, desiring popularity, think that it is to be obtained by being easy going.

Of this policy Lt.-Col. Lincoln C. Andrews says: "Be not deluded into thinking that this popularity is attained by easy going methods, by favoritism, by winking at delinquencies and overlooking failures in strict performance of duty. Such popularity fades when the real test comes, and changes to disrespect, insubordination and contempt, when real men are at the fore, leading through hardships and dangers. Build then your popularity on the firmer qualities of justice and fairness to all, inflexibility in demanding obedience and faithful performance of duty, and constant vigilance for the welfare and interests of your men, and above all, by forethought and preparation, on such conduct of your office as will inspire respect and even admiration for your ability as a leader."[1]

It is probable that the larger number of executives who fail do so because they are driven about by the winds of feeling and are the prey of moods. Today, in complacent temper, the sensitive boss will say, "Go ahead in your own way." Tomorrow, stung with jealousy, he senses encroachment on his authority, and asks, "Who gave you permission?" Or, in a gust of temper, the boss will publicly upbraid a subordinate, supersede him temporarily by giving direct orders and, walking away, pleased with himself to have shown who is boss, will leave a trail of confusion and hostility behind him.

The unhappy worker is one who does not know exactly what is wanted, nor from whom to take orders, nor how he will be treated the next time,—and this because he is working under a vague mind or a changeable temper. The traditional methods of

[1] Fundamentals of Military Service, Capt Lincoln C Andrews, Philadelphia. Lippincott, 1916, pp. 13–14. Also in Leadership and Military Training, Lieut-Col Lincoln C. Andrews, Philadelphia, 1918. Lippincott, p 27

handling such a boss are three: to take the temperature of the boss daily, and act accordingly, to flatter him and play the favorite, perhaps as informer, and to "pass the buck," remain inconspicuous, do the minimum, and keep out of trouble

It is not strictness that makes an unhappy organization, but inconsistency, and its inevitable result, unfairness. "A strict ship is a happy ship," is a proverb which has come to us from the New England coast. "It is," says Professor William E. Hocking,[1] "in human nature I will not say to stand, but to prefer, being held to vigorous standards,—but only on one condition that beneath the iron will there is known to be a complete knowledge and consideration of the limits of the human organism." From military experience Capt. Wm. H. Bell testifies similarly, "It makes little difference how rigid the discipline—how taut the requirements: if the discipline is consistent it will be a happy institution. Everything is run today as it was yesterday and will be tomorrow, and all hands know what to expect At all times everybody knows what can and what cannot be done—what is expected of him and what somebody else will do—and can adapt himself accordingly."[2]

Line and Staff.—These terms are borrowed from military administration to designate general executives and specialists. The "line" refers to officers who have general authority over groups of persons, and who are in line to succeed one another as promotions occur. Such are, in military organizations, the colonel, lieutenant-colonel, major, captain, and first lieutenant, together with the non-commissioned officers, sergeant and corporal. "Staff" refers to officers who are not in this line, but are more or less permanently detailed to some special service, or for the study of some one phase of operations

No one has described the military organization better than Major C. B. Going: "An army under a major-general is divided into brigades under brigadier-generals each brigade is divided into regiments, under their colonels and each regiment into battalions under lieutenant-colonels or majors, each battalion is divided into companies under captains; each company is again

[1] Morale and Its Enemies, Wm E Hocking, New Haven, 1918, p 138

[2] Administration: Its Principles and Their Application, Capt Wm H. Bell, Journal of the Franklin Institute, Nov, 1916, p 674.

subdivided under its lieutenants, and so on down to the corporal with his squad Promotion is step by step upward, the private may hope to be made a corporal, a sergeant, a lieutenant, a captain, a major, a colonel, a general The lines of authority and responsibility run continuously through the whole body from top to bottom.

"Staff organization is a division according to functions—division by which one military department does all the engineering work for the whole army, another supplies all clothing, or rations, etc. Staff functions are coordinate and cooperative, but they do not stand to one another in any order of ascending and descending scale. The captain, simply as captain, ranks and commands the lieutenant, that is a line relation. But the engineer, as engineer, does not command the quarter-master, the quarter-master does not rank and command the surgeon On the other hand, the captain is primarily responsible only for his own company. But the engineer builds a bridge for the entire army—general, colonels, captains, and privates That is staff organization. The responsibility of the individual is unlimited in area, but limited to one function throughout that area.

"The functions of staff and line are, therefore, not antagonistic; they are not alternative and rival systems of organization, between which we may choose and say we will adopt this or that and refuse the other. Line organization is essential to discipline and essential to the continuous existence of the whole body. Staff organization is essential to efficiency, each branch of it in its own particular function. If the commissary fails and there is no food for the troops, the engineer cannot make up for the deficiency by vigorously building bridges. Each staff must have a line organization within itself for discipline and continuity; but every complete organization must embody the principles of both line and staff if we are to secure the best results, the staff supplying expert functional guidance, applied through the line's direct control." [1]

The advance of the applied sciences, and the rise of many specialties within the field of business administration, together

[1] Adapted from Principles of Industrial Engineering, C B Going, N Y McGraw-Hill, 1911, pp 41–44 Also in Business Administration, L C Marshall, Chicago, Univ of Chicago Press, 1921, pp. 800–801

with business growth which has brought an increased mass of work of each type, have caused large numbers of specialists to be brought in from their former independent consultive relationship, and established in permanent positions within business organizations These late arrivals have been unsuited by experience and professional aim to take positions in the general executive line In some cases they have been held in a semi-detached advisory relation at headquarters, and employed there to work upon their particular phases or portions of proposed plans and general orders, these plans and orders to be given force, however, only when promulgated by the proper general executive

More frequently, and increasingly of late, the specialist has had a service department erected for him, such as an employment office, or a purchasing department, or a stock room. Such departments are ready to serve any line officer, at call, without interfering in any way with such officer's authority within his department

Correlation through Committees.—Growth in the size of plants has had an influence upon the line of general executives. It has not only increased their numbers, and absorbed each one more fully in his own department, but it has differentiated their functions, carrying them all in the direction of becoming specialists Hence the work of correlation, essential to keep operations in step, and to guide departments in harmony with a general plan, has become increasingly difficult. The higher executives upon whom this function has been increasingly concentrated have found themselves overloaded

One solution of the problem is to split an enterprise into more or less independent productive departments, each operating much as if it were a branch plant The department managers are held in a quite general way for results they have access to headquarters for consultation in case of need, and they have at their disposal at all times the services of a great variety of service departments and staff experts. Such is the direction of evolution followed by Thomas A. Edison, Inc , of New Jersey, and The Eastman Kodak Company of Rochester, N Y

The more usual solution is to tie the executives together at general headquarters by means of a council or committee A large Ohio rubber factory, which formerly had an overworked

president and three immediate assistants, now has an operating committee composed of the ten executive heads of as many divisions of the business (including 6 directors, 2 managers, and the company treasurer and chief engineer). This committee meets daily, discusses all important matters, and authorizes all expenditures up to a certain sum. Matters exceeding this expense limit are handled by sub-committees of the ten executives meeting with the appropriate higher executive A New York City bank and trust company has a similar plan. In this case there are 13 vice-presidents next to the president, each one of whom presides over some department of the business. The vice-presidents meet as an executive committee with the president daily, and transact all important business. Various of these vice-presidents are members of sub-committees which meet, as may be necessary, with the president, to transact special business.

Through such committees acquaintance is promoted, and a friendly tolerant attitude in negotiation. Different phases of matters can be quickly presented, and adjusted into final plans. The correlating general officers are enormously relieved and correlation is better done There is perhaps a less feeling of loyalty to a committee, and some questioning of obligation in case of a bare majority vote There is divided responsibility, which may induce some to let things take their course. These objections do not apply when a committee, like the cabinet of the United States government, merely discusses but does not vote—leaving decisions to the chief executive.

The committee system can be applied at any level in a business Any department head can group his assistants about him in discussion, and secure team work. The operatives in any shop may, through committees, improve the relations between management and men, and furnish a steady stream of useful suggestions for improving working conditions.

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See further the Bibliographies attached to Chapters VIII, IX, and X.

CHAPTER VIII

ADMINISTRATION: ORDERS AND REWARDS

THE SYSTEM OF ORDERS

The Regulations of the United States Army define an order as "the expression of the will of a chief conveyed to subordinates"[1] The giving of an order should represent the maturing of a project to the point where it is ripe for execution No communication between superior and subordinate is more important than the giving of an order The essence of the virility of the management goes into the contact In the order the chief opens his mind, and shows his quality. He is on display, and he is judged. As all things can be best controlled in their origins, good orders are the first means for acquiring and maintaining control

All activities in an organization should be in response to orders only In the management of the work of executive officers, where a special degree of stability is to be desired, or in the case of any performance which does not break up into small unit tasks ready for appraisal, the authorization is likely to be by force of general rules or standing orders, or their informal equivalent of established custom Otherwise, work should be in response to specific orders, which expire with the single performance, and require to be renewed or altered

In whatever way the orders are imposed, they should be relatively few in number, clear, brief but complete, prompt, in professional form, of proper tone, confined within legitimate scope, and adequately documented The response should be—and tends to be—of like quality with the orders It mirrors the order for the intellectual and temperamental qualities of the

[1] Regulations for the Army of the United States, War Department, Washington, 1917, §§ 775–790

order tend strongly to stimulate a reaction in kind Promptness, clearness, and completeness in order giving exert influence as a model for promptness, accuracy, and completeness in performance

Few Orders.—As to the number of orders to be used, it can be said that a capable management will require a smaller number than one which is incapable, for none will be wasted No order should be issued for what the superior has not the authority to direct none for what circumstances show will not be carried out. None should be issued for any performance which the management will not be able to judge. Never should a superior officer issue an order for the giving of which he is not willing to accept responsibility; as is implied in the familiar phrase of abdication. "Go ahead on your own responsibility" It was Von Moltke's rule, during the Franco-Prussian War of 1870–71, with reference to the orders issued by the supreme command to the leaders of armies, that no order should be given for anything which it was conceivable could be carried out by the proper officers without orders. This severe economy was made possible by the utmost of care and thoroughness in the choice and training of officers. A similar rule is given by Capt. William H Bell of the United States Navy: "No more orders than are absolutely essential should be issued, for unless heed to this injunction is given, all independence, all initiative, and all love of responsibility, so valuable in subordinates, will be killed "[1]

In this is embraced the idea that orders should not be given for what is involved in the regular performance of a subordinate's duties. This is, indeed, a special case of the broader rule that orders should not be given for what has already been ordered. It is folly to pile one order upon another, when authority is defective The place for restraint is in the giving of orders: for the full exercise of authority in getting them carried out. In all phases of human affairs there is friction loss between the will of the executive and the responding will of the subordinate; and that friction loss means that orders must be followed up by inspection, report, and otherwise, until the intended condition which the order is to bring about actually becomes a fact.

[1] Administration Its Principles and Their Application, Capt Wm H. Bell, Journal of the Franklin Institute, Philadelphia, Nov, 1916, p 678.

Clear Orders.—Clearness comes principally from thinking things through "Inaccurate writing," said Richard Grant White, "is the expression of inaccurate thinking" Indeed, one of the best tests of the soundness of a person s ideas is their clearness It is well worth observing, as a practical rule, that when our ideas are not clear we are likely to be ill-informed or in error Clearness is a sign of resolution Machiavelli, from whom Napoleon learned speed, decision, and unity of command, said "It is impossible to explain one's self properly when in doubt and indecision as to what is to be done· but once resolved and decided, it is easy to find suitable words"[1] The officer who is afraid of responsibility fumbles his ideas, qualifies his expressions, absorbs himself in details, and endeavors to hide his point under a rubbish heap of extraneous material

Clearness accomplishes the utmost of force, in so far as expression is concerned, for what subtracts most from the force of an expression is the suspicion in the hearer's mind that words and ideas are being used without a full realization of their significance Another virtue of the clear-cut order is that, with it, the problem of the latitude of interpretation is reduced This latitude has been very wide, in previous periods of our industrial history, not only because strict economy has not been forced upon us by nature, and military precision has not been bred into us by military training, but because executives have been inexpert, and have been obliged to depend much upon the "experience" of operatives to keep things going The large organizations of the present day require a new precision

A clear order is a strict order, in so far as its provisions reach But to attain strictness in order giving, which outruns strictness in enforcement, is to cherish a delusion As Machiavelli says "It is a certain rule, that he who gives severe orders must see them executed with severity, otherwise, he will find himself deceived"[2]

Brief but Complete Orders.—"It is an invariable maxim," says Campbell, "that words which add nothing to the sense or the clearness, must diminish the force of the expression"

[1] Discourses on the First Decade of Titus Livius, Niccolo Machiavelli, Book II, Chapter XV

[2] Idem, Book III, Chapter XXII

Clearness ministers to brevity. and brevity usually ministers to clearness. Brevity is not an important aim in itself, however; the important matters are clearness and completeness. The force will derive from the administrative policies, rather than the methods of expression. The heart of an order is the paragraph which defines the required function. This should be sufficiently full to meet the problems which experience has shown will arise as to the range of implied powers. Aside from the chief paragraph, the order, especially when it is from one executive to another, may well include information as to the general situation giving rise to the order, the general project of which the one communicated is a part, and the other agencies which will work concurrently. Such information will enable the subordinate to assist his chief in correlation.

In the Franco-Prussian War of 1870–71, orders from the German general headquarters to the army leaders, which were exceedingly brief, were composed as follows.

1. A general statement of the military situation.
2. An account of the general policy being followed.
3. An account of the present general objective aimed at.
4. A description of the part other forces are to play.
5. A statement of the part the forces of the receiver of the order are to play.

As orders passed downward, in that army, to lower administrative ranks, they increased somewhat in fullness of details.

Consideration will be given in the chapters on scientific management to the character which orders will exhibit when they reach the operatives in the shops. It need only be said, at this point, that the amount of detail in such orders will depend entirely upon the capacity of the management to supply it; and the capacity of the management to maintain shop conditions such that it can be used. It is enormously desirable, considering the complexity of modern production, that the operative should be supplied, through the medium of his order, with exact information as to the best method of working, the materials and tools to use, and the standard time in which the task should be completed. This does not so much mean a large task for the operative in complying with the order, as it does for the management in preparing it and paving the way for it.

Promptness, Professional Form, and Proper Tone in Orders.—Promptness, like clearness, arises from preparedness, and from the willingness to assume responsibility Promptness is economy. It requires a great deal of planning to get rid of the waste of "waiting for the boss," which is so large a factor in poorly organized establishments

Professional form, having to do with the proper use of technical words and phrases, indicates to the subordinate that the superior is thoroughly experienced. There is a natural satisfaction among workmen in receiving orders from someone who has been through the thing himself, or who could do the work himself if necessary.

Proper tone will depend somewhat upon rank. Between the highest executives there should prevail a deference to judgment, a free feeling as to the expression of opinion, and a diplomacy which substitutes the motive of honor for the bald force of superior authority. In lower ranks there will necessarily be more specific expression and a lessened domain for independent judgment. Some executives lose much because they cannot find the right tone This is especially true of certain crude, forceful natures which, with expanding affairs, require superior men around them but, unaccustomed to such society, continue the rude and peremptory manners learned as foreman of ditch diggers Cool, assured, decisive, and impersonal the manner of the order may be; but it must not rob the recipient of his self-respect.

The Legitimate Scope of Orders.—By an order of legitimate scope we mean that the issuing executive has kept within his own domain, and has not encroached upon the proper sphere of initiative of the receiving executive The Regulations of the United States Army provide: "When issuing field orders, a commander should indicate clearly what is to be done by each subordinate, but not how it is to be done" The sphere of the order-issuing officer is to outline the objective. The sphere of the order-receiving executive is to determine upon the best means of using the agencies at his command for attaining it. This is a logical division of labor for, unless the selection of men has been faulty, it is to be assumed that each man is competent in his own work The Manual for Commanders of Infantry Platoons, U S A, repeats the same idea: "Command is exercised in accor-

dance with the following principle· The superior determines the object to be attained, indicates his intentions, and defines the tasks to be executed by the subordinate elements: he leaves to the latter the choice of means for their execution."

The subordinate may develop and complete his orders. but it is only in exceptional cases that he is justified in disobeying them, for the purpose of better carrying out the obvious or known intentions of his chief. When subordinates are exceptionally capable, or it is uncertain under what conditions the order will be executed, a larger scope for initiative should be permitted.

Frederick the Great erred in this matter. Longman says of him: "He made his officers court disaster by literal obedience to his orders, rather than take the responsibility of acting against them even when placed in circumstances which the King could not have foreseen"[1] Fink's army of 12,000 men was lost at Maxen for although that officer knew his danger he dared not disregard his orders Likewise, General Fouquet's forces were lost at Landeshut. Frederick would not have succeeded so well as he did were it not that the less capable Maria Theresa practised the same faulty method of management, and compelled her officers to wait for detailed instructions from Vienna.

It is wise to err on the side of liberality, and give subordinates space in which to grow The greatest source of power in any organization is the force of upward striving in the ranks, which waits for opportunity A French philosopher and an American psychologist agree as to the magic of opportunity. Vauvenargues says "You must arouse in men a consciousness of their own prudence and strength if you would raise their character' Professor William James, in similar vein testified: "A new position of responsibility, if it do not crush a man, will often, nay, one may say, will usually, show him to be a far stronger creature than was supposed"[2] So Cromwell discovered himself through emergencies· and so Grant was awakened by war. It is important, therefore, that the executive should exercise jealous care to keep from encroachment. It is so easy to encroach!

[1] Frederick the Great, F W Longman, N Y, 1881 Longmans, p 156

[2] The Energies of Men, William James, The Philosophical Review, Vol 16, No. 1, p. 6

There is always a kind of compliment to one's self in doing it. The subordinate will always give way in fact, he at first dislikes to take steps alone, and he easily learns to lean upon his chief, and be safe from censure for mistakes of judgment.

Perhaps the most dangerous institution for encouraging encroachment is the conference If chief and subordinate talk things over frequently, it is almost impossible to avoid details which belong to the subordinate And once brought up, such details are easily assumed to be approved with all their consequences, if not specifically disapproved

Colonel A D Kniskern, of the Quartermaster's Corps, in giving advice to a young executive, said. "If a consultation takes place allow a subordinate to develop his plan of action before giving him his instructions, and, if possible, you should accept his plan of action rather than modify it or substitute one of your own The reason for this is that by such acceptance you not only will inspire him with confidence in himself, but give him the incentive to try and work out the solutions of the future problems which belong and arise in his group of duties I make it an invariable rule, when my subordinates come to me for advice, to ascertain first what they think should be done, and if it is possible, I always assent to their plan of action, although there are times when I believe some other plan would get better results"[1]

Documentation of Orders.—In a small business, where the close personal touch makes easy a mutual process of adjustment, it is allowable to give orders by word of mouth, but in large organizations, where executives are called upon to give more orders than they can hold in memory, or where the number of points involved in individual orders may overtax the retentive powers of operatives, or where efficiency depends upon the exact adjustment of men to each other who are not in personal contact, orders should be written A permanent objective record is advisable where considerable periods of time may elapse between the giving of the instructions and the completion of the task, or where instructions must be transmitted through a number of persons.

[1] How to be a Successful Executive—A Colonel's Letter to His Son, Col A D Kniskern, 100 per cent, Aug, 1918, pp 42–43

In a large establishment an order may pass through as many vicissitudes as a contract between independent concerns; like precautions ought, therefore, to be taken in its preparation, transmission, and recording. Written records are a safeguard against the thoughtless giving of orders. They recall the official to a realization of the importance of what he is doing, by suggesting to him that the record may be examined by his superiors. They lead, therefore, to fewer orders, and orders of better quality. A written order serves the operative while he is performing his task as a means of reference. Later it offers indisputable evidence as to what he was told to do, and so protects him against unjust censure.

It will be understood, from the discussion under the heading "A Steady Framework of Ideas," in the preceding chapter, that orders should rest upon general principles and deliberately adopted policies; and not signify, in the thought of the recipient, merely the arbitrary exercise of authority. Orders which are to be frequently repeated will gain in consistency if they are standardized, or at least frequently compared with permanent basic determinations or norms. "Under rule-of-thumb management," says Professor Richard H. Lansburgh, "action can be secured upon a problem only when the occasion arises. This results in thinking of each problem separately, so that such shops have their great body of common practices which have gradually crept in, and which are largely unrelated. Methods are variously understood and variously interpreted by those most affected. The traditions of the past are treasured up in the minds of the oldest employees, who transmit them upon occasion, much in the way that the ancient bards were accustomed to transmit the history of early times.

"In the development of standard instructions it is necessary not only to think clearly and to think through the subject of the instruction, but it is necessary to think ahead. It is evident, therefore, that standard practice instructions within a business indicate a tendency on the part of the executives of that business to think clearly, to think through, and to think ahead."[1]

[1] Industrial Management, Richard H Lansburgh, N. Y. Wiley, 1923, pp 83–84

Rewards and Punishments: Incentives

Some sort of award is the close of the cycle of events inaugurated by the order Through it the management finds one means of indicating what it prizes and puts first in importance, what it condones or ignores, and what it condemns and punishes. The system of rewards and punishments is an expression of the management's valuation. This valuation should be certain, prompt, discriminating as between the treatment of friends and enemies of the enterprise, graduated to fit the degree of merit or demerit involved, constructive because hopeful and encouraging, varied, competitive, and public, in so far as proper protection of the self-respect of the recipient will allow.

The Reward Made Certain.—Whatever the effect intended by acts of rewarding or punishing, this effect will be increased if these awards can be depended upon to take place: always the reward for the meritorious act· always the punishment for the dereliction The mere knowledge that a management has an adequate system of inspections and reports, so that it is certain that the results of operations will be accurately known to it, is sufficient, in most cases, to secure adequate response. Such assurance of answerability produces a steadying feeling of responsibility. It is more important that punishments be certain than that they be severe. As Major James A Moss phrases it: "Punishment should invariably follow derelictions of duty, for the frequency of offenses depends, as a general rule, on the degree of certainty with which their commission is attended with punishment."[1]

Prompt Reward.—It is important that the award (favorable or unfavorable) should be coupled closely with the events of which it indicates a judgment, so that the entire series will be felt, and remembered, as a single experience. Frederick W. Taylor found, in dealing with manual laborers of limited intelligence, that the full force of the impulse to do good work was only preserved when they were told of the results of a day's work not later than the morning of the next day "The stimulus to maximum exertion," said he, "should be a daily one. Two-thirds of the moral

[1] Officer's Manual, Maj. James A Moss, Menasha, Wis, 5th Edition, 1917, pp. 245–247.

effect, either of a reward or penalty, is lost by even a short postponement."[1]

With men of higher intelligence this span is longer. The International Correspondence Schools formerly paid their salesmen on a monthly basis. They found that 65 per cent of the work was being done during the last week of each month. A weekly bonus system was introduced to make sales effort more uniform Commenting upon this record Mr. John M. Bruce said: "I have yet to see a sales force where the salary averaged less than $1800 a year, that would respond to a bonus system in which the reward was more than a week away." Napoleon repudiated the policy of Cardinal Mazarin, which was to keep people as long as possible in a state of hope, and he scattered honors with lavish hand upon those who aided him. His marshals were promoted with astonishing rapidity, and became great men while still young. Their example stimulated every ambitious man in France.

Discriminating Awards.—Lt -Col L. C Andrews has described a situation which may be duplicated in almost any shop "In every group will be found natural leaders, men who, when hardships bear down the spirits of the majority, are found doing more than their share, and not only by example, but often by cheerful word or quip, are unconsciously inspiriting the whole to better endurance. The leader must find every opportunity to show public recognition of the merit of these men, thus strengthening their influence with their fellows. Give them the important missions: be sure it is such a one who is detailed to any conspicuous or daring duty; if favor must be shown, be sure it goes to such a man. Again, there are always found would-be leaders of the opposite temperament, chronic pessimists and kickers, who by example and frequently by grumblings, lower the average of endurance and performance. It is equally important that the leader undermine the influence of these men, quietly giving them the disagreeable details that often must be performed, and never making the vital mistake of appearing to approve by selecting such a man for a conspicuous detail How absolutely important then that a leader truly

[1] Frederick W Taylor, Frank B. Copley, N. Y Harper and Brothers, 1923, Vol I, p 318.

know the personalities of his men. Not only must he pick the man best qualified for the task at hand, but he must consider the effect of his selection on the morale of his group. And this demands constant observation of his men at their work."[1]

There are always the smooth "dead beats" who are trying to "put something over on the boss" The rank and file watch the contest of wits with interest. If the management fails in this vital test, and allows itself to be steadily imposed upon, its power to command respect and confidence is weakened The employer, through his rewards, his distribution of favors, and the bestowal of signs of appreciation, can steadily enhance the influence of the loyal and efficient persons in his organization, and decrease the influence of the slackers. In so doing a favorable spirit of the shop will be created.

If the discriminating use of praise and blame, and of other awards, is so essential, it may be asked why more employers do not so use them The answer is because they have not put themselves through the toil of standardizing conditions in the shops, of determining accurately what constitutes a fair day's work, of developing a system of prompt and properly individualized reports of production, breakages, seconds, absenteeism, etc., and of assembling such records in the histories of employees, so that they are in a position to tell who are the real friends of the enterprise, and who are the enemies of it.

Graduated and Constructive Awards.—Continuing the discussion of the previous section, it is obvious that awards should normally be graduated to correspond to the degree of credit or discredit of the performance Still more does this emphasize the need of adequate sources of information. When liberality or severity is out of proportion, the reputation of the management for intelligence suffers. If this reputation is that the employer is at times needlessly severe (as happens, for example, when a lax boss tries to regain prestige by harshness), the situation is created in which a single case of unfair treatment may dignify the victim of it into prominence in his shop as a martyr, and give him a sinister power to disrupt the spirit of loyalty

In all awards it is necessary to consider more than abstract

[1] Leadership and Military Training, Lt-Col Lincoln C Andrews, Philadelphia. Lippincott, 1918, pp. 30–31.

justice. None of us wants naked justice: and none of us could succeed if we received it We need understanding, mercy, love, and opportunity. It is necessary to consider the probable reactions of human nature; and the effect of acts upon group opinion. Threats create the motive to cover up facts. Censure, except in the wisest possible form, ceases to educate, and develops a blinding series of defense reactions. Fines are discredited as a tool of management. It is more productive to praise with discrimination than to blame with equal discrimination. For practical reasons, it frequently pays to follow the advice of Lord Chesterfield, when he said: "It is often necessary to appear to be ignorant of things you know, and to have forgotten what you remember."

> "Men should be taught as though you taught them not,
> And things unknown proposed as things forgot"

The executive, through his investigations, should not be thought of chiefly as hunting for failures and errors to condemn, but rather as disposed chiefly to find cause for praise, on which to distribute benefits, if only the proper persons can be found, and to enlarge the opportunities of all good men A great leader, of whom it was said that, "His greatest quality was his ability to fathom the human heart, to understand its weakness and its strength, so that he could measure the influence that must be exerted and the methods by which it could be induced to assist him in his direction of affairs,"[1] has left the following on record, "It is an old and true maxim that a drop of honey catches more flies than a gallon of gall. So with men If you would win a man to your cause, first convince him that you are his sincere friend. Therein is the drop of honey that catches his heart. . . . On the contrary, assume to dictate to his judgment or to command his action, or to mark him as one to be shunned and despised, and he will retreat within himself, close all the avenues to his head and heart; and though your cause be naked truth itself, and though you shove it with more than Herculean force and precision, you will be no more able to pierce him than to penetrate the hard shell of a tortoise with

[1] The True Abraham Lincoln, W E. Curtis, Philadelphia, 1903 Lippincott, p. 172.

a rye straw Such is man, and so must he be understood by those who would lead him even to his own best interests."

The Industrial System Defective.—The system of rewards and punishments usually employed in industry has grown steadily less effective, for all except proprietors and chief executives, as the unit of manufacturing has evolved from household and shop to the present super-factory organization The great majority of persons involved has been cut off from the vital interest of proprietorship in connection with their toil. Class after class has been excused from participation in the ultimate profit and loss of the enterprise. The managers have been excused with salaries: operatives have been dismissed with wages

In the factory of today the worker does not own the buildings in which he works, nor the materials, machines, and tools which he employs. He sees neither the preceding nor subsequent processes of manufacture. The product is not his he does not know the consumer; and it is only by chance that he may see the product rendering its service in use He does not know who the proprietors are, behind the mask of the company, and he is likely to know but few of the executives. He is seldom told what the company's policies are, and more seldom yet what its financial condition is For him, the modern process turns chiefly upon two bearings arbitrary authority and wages. Meanwhile, for a generation, there has been going on a revolution in education and prison reform, which has for its object to lessen reliance on arbitrary authority, and utilize in its place interest in accomplishment Something very important needs to be done to offset what has taken place in industry.

Games as Models of Incentive.—The most successful organized activities for drawing out the energies of participants, with a minimum of fatigue, are games Consider the advantages of a baseball game in contrast with a factory. There are the two competing teams, whose previous records are well known There is a large crowd on the bleachers and the grandstand, prompt and vociferous in praise and blame There is the intimate cooperation between members of a team And the spirit of rivalry is kept active by the sight of the work of the opposing team. The play is difficult enough to be a process of self-testing, with fre-

quent thrilling situations calling for special exertion. The score mounts point by point, followed by all, and prominently posted inning by inning, on a score board. The chain of events leads rapidly to a climax.

How much interest would there be in baseball if each inning were played in a separate field, if no one but the Athletic Association could calculate the score, if no score were made public for a week and usually none published at all, and if there were no audience except the umpire, with a referee far away in an office? To develop interest comparable to that of sport, in any activity, it is necessary to have a record or "score" known to the performers. The scores must be "matched" in competition with other organizations sufficiently near to equality to give suspense as to results All results must be more or less directly comparable with a standard of excellence or a "bogie." The climaxes of winning or losing must be interspersed frequently by breaking up performance into "heats." There must be an audience of "fans" whose opinion is intelligent. How far can industry repossess itself of these natural energizers?

Competitions and Emulations.—There are many cases of the successful translation of the daily affairs of productive industry into the terms of a game of matching records Captain Bill Jones was one of Andrew Carnegie's executives for years in charge of the Edgar Thompson Works at Braddock, Pennsylvania. A strong character, and a wonderful manager of men, he caused an enormous broom to be made, and had it hoisted over a furnace which had broken the world's record for a 24-hour production. Word of this installation soon spread through the steel industry; and the spirit of competition awoke. Soon another furnace won the record, and had its broom made and erected. And presently there was a rapid shifting from plant to plant; and figures were telegraphed between the rivals. The contests became so strenuous that the idea was eventually withdrawn. But in less than four months Captain Jones doubled the output of steel in his plant. A year later he was making steel six times as fast. And later, even this wonderful record was doubled.

Mr. Schwab, in his little book,[1] "Succeeding with What

[1] New York, 1917 The Century Company, pp. 40–41.

You Have," tells of going into a shop whose record was not particularly high. He asked the furnace foreman how many "heats" he had made that day, and on being told "six," he marked a big figure "6" on the floor with chalk. Coming through the next day he found that the 6 had been rubbed out, and in its place was a big "7," the record of the night shift. This awakened competition, the records were broken again and again as one shift followed the other, until finally that shop, from being one of the poorest, moved up in rank until it became one of the best.

Variety and Imagination in Awards.—It has been assumed that industry must be monotonous. But industry is what men make it; and doubtless it can be made a dramatic adventure, when a dramatist and adventurer is in charge. Before Napoleon's time military life had settled into a prosaic business from which soldiers deserted at every opportunity, and in which officers functioned under a deadly routine in monotonous seniority. All this Napoleon changed by his genius He came upon the European stage as the champion of a new order, and as the opener of all careers to talents His marshals, and other officers, he chose from the ranks of the common people. To the successful leaders, who brought him victories, he gave frequent and amazing promotions, and eventually the coveted titles of duke and prince. With these there went princely revenues, fine residences in Paris, magnificent estates in the suburbs, and even, on occasion, the most desirable marriages, arranged through court influence.

After military operations, those officers, of whatever rank, who had distinguished themselves, were rewarded with a smile, an appropriately friendly manner, the mention of their names, and words of praise given in the presence of their troops. Or, there would be a letter of praise, signed by the emperor Subsequently the orders of the day would mention such officers, and bulletins and proclamations would be broadcasted throughout France.

Minor officers who distinguished themselves received presentation arms, beautifully mounted guns, bugles, axes, or swords, together with special gifts of money or appointment to permanent stipends The recipients of such arms would be given

them at a special banquet in the palace, where the Emperor showed himself as a friendly companion in arms.

When a corps covered itself with glory, it might receive the distinction of being put at the head of the column to enter a conquered city; or it might be passed in personal review, even rank by rank, by the Emperor; or a dragoon per regiment would be selected to receive a cross for his regiment, personally given.

Favored regiments were given affectionate names, such as The Old Guard, and The Immortals, when written reference was made to them. And to famous brigades came magnificent flags with the names of their victories embroidered upon them in gold letters.

To civilians were sent letters of praise. For the honoring of unusual excellence in civilian activity there was organized the Legion of Honor; "a new money" of reward: "a reward for actions above reward" Through this was created a new aristocracy of talent to take the place of the fallen aristocracy of descent. In this way the nation was stirred as, centuries before in the same land, Caesar had stirred his legionaries by similar means, to the love of honor.

Men love distinctions, and social rewards; and delight in sharp groupings which evoke the spirit of common cause, and emulations with the game of self-testing strong in them. Their nature is to learn by vivid personal illustrations; and to work in spurts for nearby and tangible rewards. Modern industry is often too prosaic and too mechanical to arouse men. There is need of more badges and distinctions and honorable mentions; for more foremanships and minor executive positions to aspire to, and for more special committees to serve on. The new day in administration will see a way found to introduce into industry more spice and romance, and more exercise for the emotional nature,—more strategic play to capture the interest, and more fine, imaginatively presented aims to awaken real devotion.

Normal Incentives.—It can be said that in many ways the ideal situation with reference to rewards and punishments exists in the case of the individual who is in business for himself. Upon him, certainly, all possible varieties of stimulus, arising from his enterprise, can be said to concentrate. Such a person feels all of the normal incentives to effort. In the first place, there

is the pleasure derived from the process of working, which provides an outlet for energy, and is a process of testing skill. When a piece of work is completed, there is pride in the product or achievement, which is not only an evidence of mastery, but is something possessed of utility through which the worker may be of service to others to whom may fall the privilege of utilization Third, there is the pay or the wellbeing for one's self and loved ones, which the work will bring as a marketable value. Fourth, there is the influence of the work upon the opinions of others; and so the resulting reputation which the worker may enjoy. Without destroying any of these incentives, social or organized industry can add a delight of its own from the sense of solidarity existing in a group of persons closely associated in activity; and an excitement from competition or emulation with similar groups

Of the normal incentives to labor, President-Emeritus Charles W. Eliot has said: "Every working-man who is worth his salt (I care not whether he works with his hands and brains, or with his brains alone) takes satisfaction, first, in the working, secondly, in the product of his work, and thirdly, in what that product yields to him "[1]

The Sense of Service.—Every intelligent person has a value sense, and exercises it in the judgment of persons, actions, and things. The factory operative who completes a piece of work evaluates it—or the series of which it is a part—and infers a certain degree of worth in himself as the doer of it. If this degree of worth does not correspond with the ideal he has set for himself, there is suffering Drudgery is work done in such darkness of spirit that grounds for a satisfactory consciousness of worth cannot be found The grounds may, indeed, be there but not perceived, because some antagonism of mind obscures them. The estimate put upon an accomplishment by a factory worker will be, in part, a reflection of the opinion of his associates, and an application of the spirit of the shop, to the particular case. And the estimate will depend, in an important sense, upon what the management has done, or left undone, in the interpretation of the task

In a pungent little volume entitled, "Man or Machine:

[1] The Durable Satisfactions of Life, Chas W Eliot, N Y, 1910 Crowell & Co, pp 33–34.

Which?," Mr. Frederick Brown has drawn a vivid and pessimistic picture of modern factory conditions from the point of view of incentives. "Next to his pride of skill, the workman has always been proud to be the connoisseur: stand back near the light with his product on his upraised hand, showing to all passers-by what he has done. Perhaps it was a red morocco slipper for a dancer, or a pearl button to go on the cloak of a little child, or maybe it was a horse-shoe to go on the Mayor's carriage horse On a day a party of visitors would come to the little shop and the owner would pick up a hand-forged hammer and say, 'See what John made!'

"But in our modern industry, no one man ever completes a task. Each task is subdivided into twenty, forty, a hundred or more portions, and a workingman is given just one to work on, day by day, year by year, for a working generation. In this corner of a vast room the toe of a shoe is cut out with a mechanical die. In the basement of the factory the sole is stamped by another machine. There is a man to do nothing but bore lace holes, another to do nothing but run the machine that punches rivets in the lace holes One man sews on the toe, another sews on the sole, another polishes the sole, another blacks the heels. No one of them is going to show the little part he has done and boast of it. He rather feels ashamed of his little creation. He yawns That is all, or wonders what the baby at home is trying to say at that moment. . . . Having merely a toe, a heel, or a cross-stitch interest in the whole pair of shoes, it becomes no exciting matter to the workman what the shoes sell for, who wears them, or whether they last long . He is generally indifferent to the prestige of the shoe, and when he sees it advertised on the garden walls as 'a marvelous product of skill,' he has no responding glow or sense of pleasure."[1]

There is here set a problem of leadership If the leaders are really superior in talent and education, here is a chance for them to show what they can do Two suggestions, derived from the practice of the most progressive employers, may be offered

An Increasing Solidarity.—The first suggestion, based on the

[1] Man or Machine—Which? Al Preddy [Frederick Brown], Boston, 1912 Pilgrim Press, pp. 20–23. Reproduced with the permission of the Pilgrim Press

trend of present practice, is that the worker of the future must increasingly find his conviction of worth through his membership in a group. If it is urged that the modern worker has only a heel or toe interest in a shoe, it may be pointed out that a soldier's individual contribution toward winning battles is absurdly small, and a citizen's part in an election where millions of votes are cast is microscopic. But the soldier is under the eye of his captain, and he is proud of his company. And the citizen is known in his precinct, and may at will be a factor in the party caucus.

Tasks are not seen in scientific coldness for what they are in themselves, but are looked upon in the light of the ultimate purpose of which they are a part, or in the light of the consideration in which the leader is held, or the organization. Tasks are interesting when done for those in whom we are interested: are dignified for the dignified: and they are illuminated with a beautiful light when done for those we love.

The future in industry belongs increasingly to great and complex groups The policy must be to identify closely the individual worker with his gang, his shift, his shop, his shop committee, his company. Appropriate emphasis must be placed upon these groups and their achievements, so that the employee comes increasingly to relate his performance to theirs, and to develop pride and a series of loyalties in these larger unities

Welfare and Voluntary Activities.—A second suggestion is that a great change in the way of looking at life and labor may be wrought in the worker's mind by connecting him with a variety of welfare and voluntary activities. Organizations of employees may be devoted to various educational, protective, and social objects And their work may be supplemented by aid from the Company's service departments. The significance of these activities, to be noted here, is that through them emphasis is constantly placed, both directly and by inference, upon the supreme worth of the individual This testimony, coming from many sources, and often repeated, and interpreted in a variety of forms, will assist greatly to sustain the faltering courage of the worker, and to convince his doubting mind that the work he is delegated to do is truly worth while, and that he is a servant of society.

PROBLEMS

Lord Kitchener.—Prepare a study of the characteristics of Horatio Herbert (Viscount) Kitchener, giving attention not only to the qualities which gave success in the Sudan campaign, but to the controversy which arose as to Kitchener's efficiency during the World War

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Cecil Rhodes.—Prepare a study of Cecil John Rhodes, the British colonial and national statesman, as an executive and leader.

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Robert E. Lee.—Prepare a statement of the character, executive methods, and influence as a leader of Robert E. Lee.

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U. S. Grant.—Prepare a statement of the characteristics of Ulysses S. Grant as a military leader.

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Stonewall Jackson.—Make a study of the life and character of Thomas J. (Stonewall) Jackson, and state as accurately as you can the qualities of his military leadership

References.—H. A. White, Stonewall Jackson; Lt.-Col G F. R. Henderson, Stonewall Jackson and the American Civil War, London and N. Y, 1898. Longmans. R. L Dabney, Life of Stonewall Jackson, general histories, Encyclopaedia articles, etc.

William T. Sherman.—Prepare a statement of the characteristics of William T. Sherman as a military leader

References.—S. M. Bowman and R B. Irwin, Sherman and His Campaigns; W. F. Johnson, Life of W. T. Sherman; W. F. Force, Gen Sherman, general histories, encyclopaedia articles, etc.

Lincoln and Gen. Meade and Gen. Grant.—What was the difference between the policies pursued by President Lincoln in the general

supervision of Gen. George Gordon Meade and the policies pursued in the supervision of Gen. Ulysses S Grant, and what circumstances appeared to warrant them?

References.—Ida Tarbell, Life of Lincoln, Vol. II, N Y., 1900, pp. 131–132 and 209, John T. Nicolay, A Short Life of Abraham Lincoln, N. Y., 1904; A. Rothschild, Lincoln the Master of Men, Boston, 1906; W. E. Curtis, The True Abraham Lincoln.

The American Executive Cabinet.—What was the difference between the policies followed by George Washington, Abraham Lincoln, and Ulysses S. Grant in selecting the members of their cabinets? Which do you think was guided by the most practical and efficient policy? To what extent do you think the policies followed in each case were suited to the personality of the chief executive?

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See further the bibliographies attached to Chapters VII, IX, and X.

CHAPTER IX

RULES OF ADMINISTRATION

The discussion of the two preceding chapters is here continued by the consideration of some rules of administration, such as: the proper subordination of details, the function of understudies, the rule of matching talents with functions, the importance of a system of promotion, the advantage of preliminary preparation, the control of activities through standards, the administration of information, and the fertility of the outside point of view.

The Subordination of Details

In a previous generation, most business enterprises were run in much the way that Frederick the Great managed his affairs, keeping his fingers on everything, giving orders in microscopic detail, making clerks of his generals, and even managing the palace servants. This universal meddling was excusable in self-made men, who had pioneered their way up through every sort of work to the top. But when the affairs of these men grew large, it resulted in their carrying staggering loads of responsibility, and driving affairs forward by their own energy rather than by guiding the energy evoked from others. Their methods, in some cases, became as absurd as that of Metiochus, of whom Plutarch says, in his "Political Precepts": "Metiochus leads forth the army, Metiochus oversees the highways, Metiochus bakes the bread, Metiochus bolts the meal, Metiochus does all things, Metiochus shall suffer for it at last."

What is Unjustifiable Detail?—We have seen already, in connection with the discussion of orders, that the proper function of an order is to define an objective, and that the domain of the recipient of the order is to determine the means of attaining that objective. We have seen also that the order-issuing executive

should keep track of the general program of which the particular objectives of his subordinates are parts; and should keep the various cooperating agencies in step with each other. Any work which prevents an officer from performing the highest class of functions assigned to him, in the best manner, is detail work: and if voluntarily taken up is unjustifiable detail. To abstain from unjustifiable detail work is to save one's self for one's principal functions: and to save one's self from encroaching upon subordinates.

The definition of "detail" enlarges as we pass upward through the ranks of authority. For any one rank it expands with growth of mass of functions. As we pass from lower to higher executives, we pass units—shops, divisions, departments—with the internal affairs of which the executive must abstain from meddling in order to devote himself to the programs which are to be carried out by combinations of these units.

The army organization is thus described by Spencer Wilkinson: "In the company, to take the infantry as the type, the captain is supreme. His superiors abstain from any interference. They are concerned only with the result, of which they satisfy themselves by inspection at the end of the period assigned to company training. The battalion commander receives his trained companies and practices them in battalion maneuvers. His business is with the battalion as a body composed of four units, not with the internal affairs of the companies. In this way authority and responsibility are graduated throughout the army corps Every commander above the rank of captain deals with a body composed of units, with the internal affairs of none of which he meddles, except in the case of failure on the part of the officer directly responsible. The higher the commander the greater his authority, the more general becomes the supervision and the less the burden of detail. The superior prescribes the object to be attained. The subordinate is left free to choose the means, and is interfered with only in exceptional circumstances. Thus every officer in his own sphere is accustomed to the exercise of authority and to the free application of his own judgment."[1] In this way the responsibilities

[1] The Brain of an Army, Spencer Wilkinson, London, 1890 Macmillan, pp. 105–106.

of commanding an army are reduced to practicable dimensions, and each officer deals with but a few immediate subordinates.

As to the scope of the work of the highest authority, Mr. Julius Kruttschnitt, of the Union Pacific and Southern Pacific Railways, says: "The function of higher authority is to maintain a balance among subordinate units rather than to attempt the administration of each unit itself." [1] And another railway chief executive says: "So long as the machine works smoothly, you should be a looker-on." [2] This implies that, for a chief executive, planning and routine management are almost completely separated, and that his business is with the former.

Men of capacity often err by working with energy rather than intelligence, not seeing that efficiency does not alone mean to do a great deal, and do it well, but to be engaged upon tasks suited to one's caliber. It is clear that the executive should deputize to subordinates all that they can do better than he; but it is also necessary to deputize much work to subordinates who cannot do it so well, for the sake of functions which only the executive can do at all. Considering a single function, without reference to other functions, it is easy to say that it should be in the hands of the one who can do it best; but when the demands of other work are considered, and economy in the expenditure of executive talent must be achieved, it is necessary to add that the function should be in the hands of the least talented person who can do it adequately.

Difficulties in Deputizing.—If an executive has possessed large capacity for handling details and, in his prime, when his energies were at their maximum, was successful, that experience may easily mislead him when at a later time his enterprises have grown larger, or his energy has grown less. Of Napoleon, Dodge said: "Desire to see and do everything himself was in early years one of his greatest powers; but it became the source of much evil when later his enterprises grew and his strength declined." [3]

[1] What the Unit System of Organization Means, Julius Kruttschnitt. *Journal of Commerce*, Sept 7, 1911.

[2] Railroad Administration, Ray Morris, New York, 1910. Appleton & Co., pp. 94–95.

[3] Napoleon, Thos. A. Dodge, Boston, 1904–07. Houghton Mifflin Co., Vol IV, p. 688.

There has been a very rapid evolution of agencies of supervision—accounting systems, inspection systems, forms for reporting, office recording methods, etc.—through which the modern executive can now review almost every move his subordinates make. In this there is danger of centralization, for a subordinate who acts in the consciousness that every move may bring a criticism finds his initiative stifled Reports can easily be so elaborated that the higher executive who conscientiously goes through them will be beyond his proper domain. The function of reports is rather to communicate results than to explain the means used in arriving at them. To the highest executive, Charles E. Perkins, formerly President of the Chicago, Burlington and Quincy Railroad said: "Let stated reports be made to your adjutants if you choose, but do not take it upon yourself to see them all."[1]

Some executives wish for all the glory, and will not let subordinates get near enough to relieve them of a proper portion of their activities Some individuals, strongly energized by a sense of duty to do everything thoroughly, try in a potentate's position to practice a peasant's industry Others who reach executive ranks are afraid to face the larger responsibilities, and so bury themselves in details. The responsibilities of military leadership are often so terrifying that this lack of stamina has been frequently discussed by military writers. Upon it General Von der Goltz says: "The high executive who busies himself unduly with details often does so to throw off his inner restlessness and uncertainty with reference to great issues, and so attempts a sort of evasion Such a man, when at last forced to make great decisions, does so hastily, as if making an effort to vault over them and get by without attentively considering them."[2]

There is the difficulty that subordinates may importune for aid in detail, and that the superior thinks he should give aid when asked. Such a condition tends to perpetuate itself, for the subordinates are not weaned, and taught to stand on their own judgments. Of such assistants, Governor Gifford Pinchot has said: "There is no greater nuisance to a man heavily burdened

[1] Railroad Administration, Ray Morris, 1910. pp 94–95

[2] Adapted from The Nation in Arms, Freiherr Von der Goltz, London, 914. Hodder and Stoughton, p 74

with the direction of affairs than the weak-backed assistant who is continually trying to get his chief to do his work for him on the feeble plea that he thought the chief would like to decide this or that himself" The danger of long and frequent conferences between superior and subordinate has been mentioned in a preceding chapter.

Disadvantages of an Overload of Detail.—The executive who fills his mind with details, which ought to be attended to by his subordinates, is either robbing himself of the time to take care of his own proper work, or else he is working overtime. Continuous overtime will presently wear down a man's energies to the point that he is only fit to handle details. Our doing determines what we leave undone. Exhausted by work outside of his field, such an executive is likely, when he returns again to it, to do some important thing badly for, as La Rochefoucauld says, "We often act treacherously more from weariness than from a fixed motive." It takes much preliminary planning and skillful supervision to keep a force of subordinates up to a high mark of activity. If the leader is absorbed in something else, and this planning is not done, the force feels the relaxation and the pace slows down. If it is the business of the executive to keep the subordinate busy, then the over-occupied executive creates the under-occupied subordinate.

"How often," observes Lt.-Col. Andrews, "we see an inexperienced noncommissioned officer in the ditch with the shovel, while a wise private smokes at ease on the bank. There is no one thing more conducive to dissatisfaction than for the leader to allow certain smooth 'dead-beats' continually to put it over on the others who must do their share of the work. No, you had better be in observation, and using your faculties to see that the 'smooth ones' get their full share. This will add to esprit."[1]

Advantages of Proper Subordination of Detail.—The advantages of properly subordinated detail are enjoyed by both superior and subordinate The subordinate gains, because he comes closer to his chief, and is a true lieutenant—perhaps an understudy—ready for promotion. Proper deputizing means to the

[1] Fundamentals of Military Service, Lt Col, Lincoln C. Andrews, Philadelphia, 1916 Lippincott, p 28.

subordinate an opportunity to do tasks large enough to arouse interest, the freedom to bring himself to bear upon his work in his own way, and a decent dignity in the eyes of those over whom he is set to rule. Liberty, which looks like license from above, may look like opportunity from below. Minor mistakes are a minor matter; but it is a major mistake to prevent them at the expense of extinguishing the initiative and alienating the spirit of the subordinate ranks. Robert E. Lee's practice of giving great latitude to his division commanders in the field has often been praised, because it utilized the knowledge of the men on the spot, and secured intelligent cooperation from them.

The superior gains also, because his mind is freed from the anxiety of details, and has sufficient strength to hold firmly to its decisions on important matters of policy. In his own domain the supervisor can see situations broadly. He can perceive the subordinate character of matters which appear decisive to those who are immersed in them. And he is at liberty to consider means for making up in another department what is lost in one part.

The principle of the subordination of details aims to define the lower boundary of the work of an executive. As there is an upper boundary of appropriate activity, as well as a lower, for any executive who has superiors over him, there must be a principle which has for its purpose to elevate responsibilities of a general nature out of subordinate hands, and pass them up to their proper administrative level. Emphasis upon the upper boundary of proper functioning may be necessary, in an individual case, to restrain a presuming subordinate, or to recall a genuinely devoted subordinate from his dream of assisting in great enterprises, back to his specific task. The object of upper and lower boundaries and definitions is, in all cases, to secure concentration of the energies of the individual upon his own proper functions, so that they shall not be neglected.

Frederick W. Taylor, himself a strict disciplinarian, very positively expressed his view as to the attitude which should be taken by a subordinate. Illustrating from his own experience, he related that as a young man he was foreman of the machine shop of the Midvale Steel Company. One of his functions was to keep the machines of the establishment going with as little

lost time as possible. His mind, however, became filled with projects for devising new machines and for revolutionizing the methods of the establishment. So much of his energy did these projects absorb that the other work suffered. He was finally brought back to his proper functions by the most severe reprimands from his superintendent who, finally, as he said, " beat it into my dumb head that I was there to serve him, and not to work in the interests of the company according to my own ideas, when these conflicted with his."

On the basis of this experience, Mr. Taylor told an audience of Harvard University students: " Every day, year in and year out, each man should ask himself, over and over again, two questions. First, 'What is the name of the man I am now working for?' and having answered this definitely, then: 'What does this man want me to do, right now?' not, 'What ought I to do in the interests of the company I am working for?' not, 'What are the duties of the position that I am filling?' not, 'What did I agree to do when I came here?' not, 'What should I do for my own best interests?' but, plainly and simply, 'What does this man want me to do?' " [1]

It should not be overlooked that, while a subordinate is faithfully doing his work, he can, within his " area of discretion " as to the manner of doing it, clearly indicate his fitness for higher duties. There will come to him the opportunity to suggest improvements and, while loyally carrying out orders, to register an intelligent dissent of opinion. There is always the opportunity for performance plus—the doing of a little more than the employer expects. Through these means he can make good the element of truth in the saying that responsibilities are more assumed than conferred.

Understudies

It may be offered as a rule of practice that an organization should provide for succession in authority by means of a system of understudies, or a carefully graduated scale of executive positions. If positions are arranged like a series of steps, up

[1] Frederick W Taylor, Frank B. Copley, N Y Harper & Brothers, 1923. Two volumes, Vol I, pp 130–132

which talent can climb, there will be, for each place, a subordinate who assumes the significance of a candidate. "Without lieutenants without counselors," is a maxim. Certainly capable subordinates stimulate their chiefs by putting them on their mettle to make a good showing. Understudies prevent executives from thinking that they are indispensable: that is to say, that they have perfected a monopoly.

The leader who desires to stand clear of subordinates, in order to receive all the credit, must, in these days, be surpassed by executives who can win energetic cooperation, for great achievements are only possible through organization. To those who know an organization from the inside, the greatest test of a leader will be his ability to surround himself with men of capacity. Machiavelli says on the point, "The first opinion which one forms of a prince, and of his understanding, is by observing the men he has around him; and when they are capable and faithful he may always be considered wise, because he has known how to recognize the capable and keep them faithful. But when they are otherwise, one cannot form a good opinion of him, for the prime error which he has made was in choosing them."[1]

To those who only know an organization from the outside, the credit will always appear to belong to the chief. As Gracian says, "All the glory of exploits reverts to the principal actor: also all the blame. Fame only does business with principals."[2] And with this Jomini agrees, "The nominal commander of an army always receives almost all the glory of its success, even when least entitled to it.[3]

Talents and Functions Should Harmonize

We offer the general rule that talents and functions should be in harmony. These, of course, are far from being mathematical quantities. Talents are largely unknown in advance of test. Functions are enlarged by talent and dwarfed by the lack of it. Which should be favored in the adjusting process cannot be fixed by rule. A new organization may aim at a symmetrical construc-

[1] The Prince, Niccolo Machiavelli, Ch XXII.

[2] The Art of Worldly Wisdom, Balthasar Gracian, London, 1913. Macmillan, p 36.

[3] The Art of War, Antoine Jomini, Philadelphia, 1863. Lippincott, p. 56.

tion, trusting to selection, transfer, and training to fit its officers to their functions. An older organization will think more of preserving its true-and-tried officers and the morale they have brought to pass in the ranks.

There are a great many ways of constructing an organization: while tried men of capacity are never numerous The alternative policies are forcefully defined by Nietzsche, "Great statesmen, and in general all who have to employ many people to carry out their plans, either choose with great skill and care the people suitable for their plans, and then leave them a comparatively large amount of liberty, because they know that the nature of the persons selected impels them precisely to the point where they themselves would have them go, or else they choose badly, in fact take whatever comes to hand, but out of every piece of clay they form something useful for their purpose. These latter minds are the more high-handed, they also desire more submissive instruments, their knowledge of mankind is usually much smaller, their contempt for mankind greater than in the case of the first mentioned class, but the machines they construct generally work better than the machines from the workshops of the former."[1]

It is useless for the constructor of an organization to frame definitions of ideal men, and try to fill the specifications Especially is it useless to look for all-round men. The organization as a whole should be the ideal, each individual in it perfecting the other; the organization is the all-round thing, each individual supplementing the other. "The management does not 'manage' if it perpetually changes its men. It should bolster up the man who lacks self-confidence; it should puncture false ambitions, and it should use men as they are found in the organization"[2]

There are many exceptions to the rule of matched talents and functions. An excess of talent, or latent talent, is looked for in promotion. Frederick W. Taylor desired, in the case of a job that was not standardized as to methods, that a man should be chosen who was too good to be kept at it permanently, the

[1] Human, All-Too-Human, Fr Nietzsche, Chicago, 1908 Kerr and Co, § 458.

[2] The Human Factor in Works Management, James Hartness, N. Y., 1912 McGraw-Hill, p 142

reason being that such a man would improve the methods, after which he could be transferred to other tasks. In this case the real job is not current performance but the expertizing of methods After a job had been standardized, Taylor desired a man who was at first not good enough for the position, with the expectation that he would develop to it. and would remain permanently contented in it.

This idea of a deficiency rather than an excess of talent is generalized—though quite independently—by Hartness: "Each position should be filled by one who wants it. one who knows he is 'better off' in it than in any other place he can find. Dissatisfied men are burdens. It is better to have each position filled by a man who is barely competent to fill it than to have it filled by a man who should have a much better position."[1]

"The dull man is harder to show, but the most dependable," says a writer in the American Machinist, "after he once gets it through his head. It is cheaper to hire a dull man and put him on a dull man's job, and have him stay than to hire a dozen bright men, break each one in quickly, and have them chasing each other out of the shop" [2]

Moral Character.—All talents are greatly enhanced in value when to them is added moral character, because this gives the promise of energy, loyalty, steady growth in ability, and economy in supervision. Upon this point of moral character the words of Cromwell should be pondered well, for his achievement in the choice of men was one of the most remarkable in the entire range of military history He said, in reporting his conversation with Hampden "'Your troops,' said I, 'are most of them old decayed serving-men and tapsters, and such kind of fellows, and,' said I, 'their troops are gentlemen's sons and persons of quality Do you think that the spirits of such base and mean fellows will ever be able to encounter gentlemen that have honor and courage and resolution in them? You must get men of spirit, and of a spirit that is likely to go as far as gentlemen will go, or else you will be beaten still.' He was a wise and worthy person, and he

[1] The Human Factors in Works Management, James Hartness, N Y, 1912, pp 68–69

[2] The Modern Foreman What is His Present Job? American Machinist, May 9, 1918, p 799

did think that I talked a good notion, but an impracticable one. Truly I told him I could do somewhat in it. I did so and truly I must needs say that to you, impute it to what you please: I raised such men as had the fear of God before them, and made some conscience of what they did, and from that day forward, I must say to you, they were never beaten, and wherever they were engaged against the enemy they beat continually. And truly this is matter of praise to God, and it hath some instruction in it, to own men who are religious and godly."[1]

Fill Positions by Promotion

It is a good rule of administration to fill positions, as far as possible, by the promotion of persons who are already associated with the organization. The character of such persons is known, and there is a record which tells much about them. And the persons know the organization: its ideals and methods, its facilities and service departments. And they are broken in to an adjustment with its activities in many ways. Much apprenticeship time can be saved.

To facilitate promotion, positions should be arranged like the steps of a stairway or the rungs of a ladder, so that each place is a preparation for the next higher one. No adjacent positions in any sequence should be so far apart, in the talent or special knowledge required for them, that a good man cannot pass from one to the other. If steps are missing there are created below the break certain blind-alley positions, the holders of which must look outside for their future: and above the breaks there will be places which must be filled from the outside or by transfer from some other line. It is one of the services of scientific management that, in its functional foremanizing, and its elaboration of the planning room and other service departments, it has created many new positions in the lower ranks of administration close to operatives. This facilitates the promotion of men from the ranks.

It was one of the leaders of scientific management, Mr. Frank B. Gilbreth, who conceived that all the positions throughout an establishment should be firmly laced together by functions

[1] Oliver Cromwell, John Morley, N. Y., 1900. Century Co., pp. 120–121.

of teaching and learning. This he called the *three-position plan*, and he thus described it. "The three positions are as follows: first and lowest, the position that the man has last occupied in the organization, second, the position that the man is occupying at present in the organization; third, and highest, the position that the man will next occupy In the first position the worker occupies the place of the teacher, this position being at the same time occupied by two other men, that is, by the worker doing the work, who receives little or no instruction in the duties of that position except in an emergency, and by the worker below who is learning the work. In the second position the worker is actually in charge of the work, and is constantly also the teacher of the man next below him, who will next occupy the position. He is also, in emergencies, a learner of duties from the man above him In the third position the worker occupies the place of learner, and is being constantly instructed by the man in the duties of the position immediately above "[1]

It is not enough that the ladders or stairways of promotion should be constructed; they must be kept open An officer who stagnates, blocks a line below him, and leaves a place above without a candidate in reserve A promotion program is always in danger, from the motive which the management is sure to feel, to leave undisturbed in his place a man who is productive and profitable, even though he may deserve better work.

The energy and enthusiasm which a promotion program will arouse in a force will depend upon the basis on which advancements are made. There is a strong motive to make this basis seniority It seems plausible that length of service should give experience. There is a feeling of obligation to members of the "Old Guard" Nevertheless, seniority is a thoroughly bad basis for promotion

Merit as the Basis of Promotion.—It is customary for men and women of ability and ambition, who believe that merit is the basis of promotion in their organizations, to give an extra service above what the current wage pays for, as a bid for attention—in short, a bid for promotion. Wages do not balance the

[1] The Three Position Plan of Promotion, F B and L M Gilbreth Annals of Am Academy, Vol 65, 1916, pp. 289–296. Also in Business Administration, L C. Marshall, Chicago, 1921 Univ. of Chicago Press, pp 185–187

account for such services: a part of the expected reward is advancement. If then an organization fills positions by promotion from its own ranks, and does so on the basis of merit, the entire force may be aroused to make promotion records by performing their tasks in an exemplary manner. But if coveted vacancies are filled by bringing in persons from the outside, or if promotions are made by seniority or favoritism, then the management has given notice, as clearly as if it had posted the information upon its bulletin boards, that no excess of service, above what current wages pay for, is wanted or will be noticed.

The advantage of a promotion system based on merit lies in the awakening of ambition. In such a system each subordinate is a sort of standing challenge to his superior. Each promoted person becomes a symbol of what may happen to others. And if some of the higher executives, including especially the president or the directors, are men who started at the bottom in the works, all persons will feel assured that the merit system is firmly established Under such circumstances the loss occasioned by the death or resignation of a valuable employee may be partly offset by the stirring of a new ambition all the way down the promotion line.

Preliminary Preparation

It is increasingly becoming a rule of good business that planning should be carried out preliminary to execution Such a rule is a special case of the division of labor; being a division of functions as between times, as also it may be between persons. To plan first, and execute later with a plan, is a reasonable procedure, because performance so engrosses the mind that there is not enough energy to do justice to planning concurrently During the schedule of performance time cannot be taken to stop and study. Furthermore, performance, when it is a familiar routine, does not arouse original suggestions in the mind, as does the body of new ideas gathered in the research incident to planning.

Preliminary preparation is a means of increasing force, for it stores up a product of work in the form of intellectual mechanisms, or material assembled or equipment perfected, which can be used later to render the current output of energy more effective. For

a similar reason it is a means of increasing speed It is a form of taking the initiative, being a kind of initiative before initiative, just as the preparation of war plans is a kind of opening of hostilities before hostilities are declared. And it agrees with the policy of taking the initiative in execution of plans, for only that can be specificially planned for which one is to initiate himself. Thus it increases the power of seizing the strategic moment. To illustrate, The Dennison Manufacturing Company, by preliminary planning, accumulates a reservoir of ideas relating to new merchandise. When times are depressed, and there is much sales resistance, the strategic moment has arrived, and these ideas are brought out to stimulate demand

Preliminary preparation is a rule of efficiency for the individual executive, as for the organization "You see regular officers," says Lt-Col Andrews, "conducting some work, detraining a command, breaking a camp, what you will, everything working smoothly, and seem to think that the officer does this by inspiration In reality, if he does it smoothly, it is only because he has anticipated each step and planned ahead for it."[1] The greatest of military geniuses said of himself, "I am always working. I think much If I appear always ready to meet every emergency, to confront every problem, it is because, before undertaking any enterprise, I have long considered it, and have thus foreseen what could possibly occur. It is no genius which suddenly and secretly reveals to me what I have to say or do in some circumstance unforeseen by others, it is my own meditation and reflection. I am always working—when dining, when at the theatre. I awaken at night in order to work "[2]

The most stupendous case of preliminary planning ever carried out with modern scientific methods, before the World War, was that of the Prussian General Staff for the Franco-Prussian War of 1870–71 In this case the plans used were completed in Berlin in the winter of 1868. The equipment of every soldier was in storage in nearby armories. Complete sealed orders for assembling, marching, traveling, and final destination were distributed to each commander. A complete schedule of

[1] Fundamentals of Military Service, Lt Col. Lincoln C Andrews, Philadelphia, 1916 Lippincott, p 29

[2] Maxims of Napoleon, N Y, N D Putnam, pp 14–15

loading and unloading points, train movements, and refreshment stations was worked out. Supplies were deposited at all necessary points. Von Moltke dryly concluded his description of the system by saying, "When war was declared, it needed only the Royal signature to set the entire apparatus in motion with undisturbed precision. There was nothing to be changed in the directions originally given; it sufficed to carry out the plans prearranged and prepared." [1]

Control Operations through Standards

Rational conduct is that in which the individual actions are brought under the control of a body of principles. Rational administration of an organization, likewise, is that in which individual performances are brought into harmony with a body of standards. The original conception of a standard is of something standing, permanent, and stable. From this comes the idea that what is fixed may be used as a signal or mark or point of reference, like a royal standard in battle, about which many can rally, or after which they can follow.

If it is ordered that 2100 cu. ft. of fresh air per occupant shall be forced into a room, per hour, by mechanical means, a standard is set from which to infer standards of equipment and operation for the ventilating system. If the purchasing department specifies that "In the pigment of white paint in no case shall the sum of the basic lead carbonate, basic lead sulphate, and zinc oxide be less than 85 per cent by weight of the mass," performance rests back upon highly measurable natural qualities. If the rule is laid down that "Employees are expected to be at their places of work at the time given for starting and stopping," a work-place schedule is brought into relation with the time-clock schedule. If the employee is told, "Do not do your part of the job, if it is not up to the required standard when you receive it," or if there is the requirement, "Always show the first piece finished on a lot to the inspector before proceeding with the second," there will be inferred a multitude of standards of quality.

[1] The Franco-German War of 1870–71, Field Marshal von Moltke, N Y, 1892 Harper and Bros, pp 5–9.

The process of standardization is the attainment of such an intimate and thorough administrative control that every case of performance conforms to the rule laid down When performance depends upon a variety of factors, standardization means the control of all the factors. When one factor is brought under control, the circumstances which cause the variation of the other factors are more easily studied Each step facilitates the next. Mr. F. W. Taylor has said, "Complete standardization of all details and methods is not only desirable, but absolutely indispensable as a preliminary to specifying the time in which each operation shall be done."[1] Standardization means uniformity. Ideal standardization, or standardization used as an instrument of efficiency, means uniformity in using the best This element of uniformity facilitates mutual understanding, and by determining what is to happen makes possible preliminary preparation.

There is an advantage in standardization, because it sets the best decisions to govern the average run of decisions When a set of rules has been carefully worked out, the effort to bring all instances into conformity with the rules is the effort to impart to all instances the widsom of the rule. Such an undertaking is a true "transfer of skill" from the management to the operative. Instead of judging performance by the chance ideas,—themselves unscrutinized—such as may rest in the mind, as a result of haphazard experience, which for the most part will merely reflect individual opinion, and can stand little higher in requirement than the mediocre average of past performance, standardization aims to establish a rule which has been born of due consultation, is founded upon research, and which aims at a reasonable approach to the ideal. In forming a body of standard rules, the executive is recalled to consciousness of what he is doing, and is put on his mettle, by the importance of the undertaking, and the publicity that is to be given his product

The rule of reason in the use of standardization was admirably stated by Morris L Cooke in his report "Academic and Industrial Efficiency,"[2] made in 1910 to the Carnegie Foundation for the Advancement of Teaching One paragraph in this report is as

[1] Shop Management, Am Soc of Mech Eng, Paper 1003, Sec 284

[2] Academic and Industrial Efficiency, Morris L Cooke, N Y, 1910 Carnegie Foundation for the Advancement of Teaching, Bulletin No 5, p 6.

follows: "A standard under modern Scientific Management is simply a carefully thought out method of performing a function, or carefully drawn specification covering an implement or some article of stores or of product. The idea of perfection is not involved in standardization. The standard method of doing anything is simply the best method that can be devised at the time the standard is drawn Improvements in standards are wanted and adopted whenever and wherever they are found. There is absolutely nothing in standardization to preclude innovation But to protect standards from changes which are not in the nature of improvements, certain safeguards are erected These safeguards protect standards from change for the sake of change All that is demanded under modern scientific management is that a proposed change in a standard must be scrutinized as carefully as the standard was scrutinized prior to its adoption, and further that this work be done by experts as competent to do it as were those who originally framed the standard. Standards adopted and protected in this way produce the best that is known at any one time. Standardization practiced in this way is a constant invitation to experimentation and improvement."

Gather and Distribute Information

An important phase of the work of every business organization is to serve as an agency for the gathering and distributing of information Both gathering and distributing should be normal functions, and not the merely casual activities of interested persons.

The tides of information in and out will correspond with the movements of administration. Facts will be distributed with orders, rules, and bulletins; facts will be gathered in reports, suggestions, and interviews. Every service department, and almost every executive officer, secures information which, entirely apart from its use in control, has value for other divisions of the business

Reports.—The principal agency for transmitting information from lower to higher executives is the report. Many practical men are suspicious of reports, and prefer to trust to direct observations The scope of direct observation is severely limited. Undoubtedly the offices of the business world are full of reports

which did not play up essential facts in proper proportion, or which were out of date when received "By far the greatest value of accounts and reports," says the Bureau of Municipal Research, "lies in making the facts currently available That is, if the statements of facts are to be used as a basis of judgment, they must be before the officer when judgment must be exercised A report which comes in after it is needed as a basis for administrative judgment is only an annoyance. . . . The frequency with which reports should be made depends upon the frequency with which judgment should be exercised Regularity is essential in order that the officer may know when information may be expected"[1]

An intelligent record: prompt, compact, accurate, and arranged to emphasize those relationships between facts which correspond to vital points in control, forms the most convenient, permanent, comprehensive, and unprejudiced testimony as to conditions which an executive can secure. B A Franklin has given compact testimony in appreciation of the ideal record "Records built on specifications showing vital and significant facts, with enlightening details, proved with accuracy, made definite and understandable by periodicity and arrangement measured by standards and comparisons and covering the field and each section of it with ample and comprehensive scope, make for the executive with a desire to get a grip on his affairs the most powerful subordinate he can obtain"[2]

Knowledge Possessed by Employees.—There is a great body of knowledge in the minds of the rank and file of employees, not alone with reference to the crafts and skills in which they are engaged, but with reference to working conditions, foremanizing, soldiering, qualities of materials, condition of equipment, rules that are obstructive, and rules needed, in fact upon every phase of the business with which they are in contact Only minute fractions of this information ever come to the knowledge of the

[1] Handbook of Municipal Accounting, Bureau of Municipal Research, N Y, 1913 D Appleton & Co, pp 161–162

[2] Records as a Basis for Management, B A Franklin, Vice-president Strathmore Paper Company, Management Engineering, Sept, 1922, pp 133–137 Also in The Modern Executive, Daniel Bloomfield, Editor, N Y Wilson, 1924, pp 236–250

foreman: much less passes him to higher authorities. Sometimes a glimpse of the worker's mind is given to an interviewer in the employment department, as an employee quits work. Suggestion systems may bring out a small part of what the workman could suggest in the way of improvements. But in many shops, for a workman to tell what he knows that would be useful in the promotion of efficiency, would be equivalent to asking for his discharge.

Knowledge Possessed by Consumers.—Of the consumer's wrath at incompetency of design and shoddiness of manufacture, what record is ever made that reaches to the proper ears? The consumer exercises a sort of postponed veto through his choice of replacement articles, when there is an alternate product on the market; but of the reasonable dissatisfaction with first purchases little is ever reported. In some instances, in connection with sales and advertising campaigns, there are house-to-house canvasses to tap the enormous reservoir of popular knowledge. One manufacturing concern, at least—The Dennison Manufacturing Company—maintains a number of retail stores, in order to be able to find out what the consumer wants, or doesn't want, and why. Demonstrators are also sent out to teach new uses for its products to classes of consumers, and to report back the information gathered.

The Expanded Order.—The second part of the problem of administering knowledge is to distribute it to the persons within the organization who will use it. The strategic moment for information is when an order is given. It is certainly more profitable to forestall mistakes by ample information with the order, than to account for them with ample information in the report. Nevertheless, reports are probably more complete than orders. One of the accomplishments of scientific management is the expansion of the order to include a variety of information about the task, which the operative, who aims at a first-class performance, should possess, but which he cannot procure for himself. The order should aim to reveal to the mind of the operative whatever of elegance of means or refinement of art is known in connection with his task, so that something of intellectual significance shall rise out of it to arouse his interest, and give him ground for self-respect in his accomplishment.

Associated production, engaged as it often is in processes which are months away from completed utilities, expects men to be interested in directing their energies into a void, where they are lost to calculation for a week, or a month, or perhaps forever, except as remote inferences can be drawn from occasional promotions and discharges. Mr. W. H. Mallock[1] has explained that the work of the leader is to construct out of ideas a sort of go-cart in which weaker intellects can be wheeled along more rapidly than they could go with their own powers of locomotion.

It is the leader's privilege to interest, arouse, convince, bring to decision, stir from the paths of habit, guide, and sustain. He is to explode fallacies, supplement partial views, demonstrate the true nature of things, bring the future near, divide discouraging goals into practicable parts and, in general, lead out of bondage and through the wilderness into a land of promise. Adequate information sets up a court of reason, banishes the harsh reign of "Do this because I say so," and substitutes a government by consent based upon permanently established, public, and impersonal facts and principles.

Full Information for the Worker.—The traditional avenue of all information passing to the ranks is the foreman. The more progressive employers are increasingly supplementing the work of the foreman by books of rules, bulletin boards, the introductions of the employment department, and house organs, as well as by the systematic instruction of vestibule training departments, apprenticeship courses and Americanization courses.

The worker has a right to learn from his managers all that his intelligence craves with reference to the significance of the work he is engaged in, the relations of other workers or shops to him, and the character and extent of his company's activities. The corporation is the economic family. The individual who joins it naturally wishes to know its history, the struggles attending its early growth, its notable achievements in war, its triumphs at expositions, its service in times of public disaster, its administrative and financial structure, the variety of its products, the range of activities carried on by its various departments, the

[1] Aristocracy and Evolution, W. H Mallock, N Y Macmillan, 1901, p 137.

markets it reaches, and its ideals of quality, or low price, or prompt service.

The Committee on Economics for Employees of the American Management Association has said "Since the study of applied economics is designated to create a better understanding between managers and workers, we believe that every company, as one of its first lessons in applied economics, ought to exhibit and explain to its employees its annual financial statement, showing assets and liabilities, its main disbursements, over-head, production and sales costs, its profits and losses, earnings or surplus. The doing of this will do more to develop understanding and cooperation than any other one thing, provided, of course, the statement safely can be shown to employees. If it cannot be shown, because it conceals or reveals some unsound economic policy, the question arises whether the management ought not immediately to set its house in order, clean out the skeletons, and let the light of day in on its business conditions and policies, and its industrial relations."[1]

Many employment departments now give to new employees a booklet with facts as to the company. Some of these books, issued by the larger corporations, present such a fascinating range of information that the new member may well feel as if, in joining, he were doing something almost as important as becoming the citizen of a new country. This printed information is sometimes supplemented by introductory talks and by tours of the plant. The average factory worker is not the type of person who could have managed one of the traditional crafts. Nor would he be happy with the anxieties of management placed on his shoulders. In fact, it is usually a pitifully small amount of information about his environment and his duties that suffices to make him contented.

Economic Problems.—An exceptional brooding mind here and there in the shop, however, will turn over the troublesome questions of economics, and find in them materials to feed the fires of resentment. Does not labor produce everything? If money does not breed, why should interest be paid? Isn't there plenty of wealth in the world to pay much higher wages? How

[1] Teaching Economics through the Employee's Publication, D. C. Vandercook Industrial Management, May, 1925, pp 308–311

did rich men make their fortunes, if not by a kind of robbery? Do officers do any work? What do stockholders do, to deserve dividends? What about watered stock? Machinery replaces labor: the faster it runs the more men are out of work. There is just so much to do: don't work yourself out of a job. What advantage is there for the majority in the system of individual initiative? Isn't competition so wasteful that it ought to be abolished? These topics are exploited by trouble makers. The worker may very logically look to his employer for assistance in understanding the existing economic order, and in distinguishing between practical reform and destruction.

Knowledge and Morale.—As an organization increases in size, the problem of coordinating the activities of the parts, of reducing the friction and lag between headquarters and the ranks, and of creating among its members a condition of good morale, with devotion to the common undertaking, is increased in difficulty. One means of solving this problem is to educate each individual more thoroughly, so that he assists in solving the problem of coordination in so far as he himself is concerned, and so that he extinguishes friction within himself and becomes a driving force rather than a drag, and so, finally, that he rises to the conception of the larger whole, and lives in the light of a larger idea than he would have grasped otherwise.

Professor William E. Hocking has written of knowledge in relation to morale in war. Knowledge bears a like relation to morale in a business organization. "Morale is at bottom a state of will or purpose: and the first factor in any mature human purpose is *knowledge*, i.e., knowledge of the thing to be gained by the purpose,—the good to be reached or the evil to be averted, or both. Hence, in any development of military morale the supreme worth of the *aims of the war* must be made the object of particular care.

"Nothing could be more powerful as a morale-making agency than the action of a nation which should, as it were, lay its cards on the table before its soldiers in training, and say, 'These are the data upon which our decision is based: this is the history of the case: these are the principles involved, judge for yourself.' "[1]

[1] Morale and Its Enemies, William E. Hocking, New Haven, 1918 Yale Univ Press, pp 150–151.

The Outside Point of View

It may be appropriate for operatives, and for the lower ranks of executives, who are much immersed in details, to aim chiefly at ease and habitude in the handling of the intellectual aspects of their work. Such may desire to attain as great a degree of facility in a restricted field as possible; and to that end may narrowly confine their attention. But the higher executive deals with problems which touch upon, and are determined by, a wide range of factors. His affairs may be much affected by a revolution in China, or an experiment being conducted in some college laboratory, or a method of administration being tried in some prison or hospital or army. He is called upon to view his problems broadly and to travel the boundaries of his enterprise. Normally, his function may be to make improvements along traditional lines; but suddenly his great duty may become that of precipitating revolutionary changes. He must beware of narrow habit-confined pathways; and must range widely with flexible, inquiring mind. To such an officer it is a vital matter to secure for his organization the fertility of the outside point of view.

It is a matter of common observation that outsiders see with vividness and observe unconventionally. The traveler in a foreign country sees what the natives are too much accustomed to for attention. Even the executive, back from a vacation, looks about for a few hours with a strange feeling of objectivity, and senses defects and limitations vividly. From a given body of knowledge within the mind, the number of useful inferences is limited.

If a new body of knowledge be brought in, the flow of suggestions immediately begins again to pour forth This new knowledge or new body of experience may be brought into contact with the practice of an organization by bringing in the outsider. Thus, the superintendent of another plant which has just installed a system of move-men with elevating trucks, may see vividly the defects of a plant he is visiting, in this particular phase of operations. An illuminating engineer may observe employees squinting in the face of glaring lights. A mechanical engineer may notice the idle over-run of machines. A doctor may take note of the bad air: a teacher may see men mishandled in the learning process, a fire insurance adjuster may notice the

bad elements of fire risk. All of these persons come with unusual bodies of knowledge, against which the things seen are projected in sharp relief

A more difficult project is to increase the originality of one's own thinking. In making efforts to escape into a world of more profitable ideas, it should be noticed that there is a rule in scientific research, that all exceptional cases, either of condition or performance, whether above or below the average, should be given special attention. Such cases are special for the reason that the causes are unusual. The causes may be unusual in either promise or threat. This rule can be utilized in reverse order, for if exceptional circumstances can be found, they may be trusted to bring forth exceptional solutions. Used in this way the rule may be called the rule of stress. Where have good men been put under special stress? Where has it been particularly difficult to reach a satisfactory solution of some problem? A fire department of a modern city may be studied for time-saving methods The lighting system of an art gallery, or a photographic gallery, or an operating room, may show improved equipment. The United States mints will employ exceptional precautions for preventing material waste. The train dispatching of a railway system may contribute ideas to other lines of industry A census office may help any large business in tabulation.

In the search for new ideas an executive should examine practice in lines different from his own. A successful manufacturer of men's clothing avoids, during his vacation, those plants which are in his own line, and visits manufacturers of tents and sails, harness and leather goods, and the extremes of the needle trades, both fine and coarse. The executive should not be daunted by the idea that his technique is something special, so that those outside of his particular craft can give him no suggestions. The idea of the "very special" is always a sign of insufficient experience Techniques are not exclusive, even when mechanical, as those know who have seen the sewing machine applied to a hundred kinds of work, or who have seen press work and forging dispossess the casting process from a considerable fraction of its field. Still less are manual processes exclusive Motion study and time study were carried from machine shops into sport, and revolutionized the calculations of baseball And

least of all is there anything exclusive in the nature of those problems which have to do with the handling of human nature.

The original mind is the one which travels more boldly about in the world of ideas than others, adding range of vision to thoroughness. Men differ not so much in their original mental powers as in their skill or good fortune in getting their minds upon the connections between important bodies of ideas, while others remain fastened upon some one stock of concepts.

Problems

Definitions in Administration.—Procure the best dictionary definitions for the following words

Administrator	Manager	Premier
Executor	Cicerone	Champion
Leader	Captain	Exponent
Guide	President	Superintendent
Counselor	Chairman	Director
Mentor	King	Czar
	Kaiser	

Maxims of War.—General Karl von Clausewitz, the originator of scientific military instruction in Germany, in his book, On War, laid down the following principles

" The first and most important maxim which we can set before us is, to employ all the forces which we can make available with the utmost energy.

" The second principle is to concentrate our force as much as possible at the point where the decisive blows are to be struck.

" The third principle is not to lose time.

" Lastly, the fourth principle is to follow up the success we gain with the utmost energy "

To what extent, and through what general agencies, can a business executor employ these principles?

Mature Reflection versus Sensuous Impressions.—General von Clausewitz, to whom reference was made in the problem above, in his " Instructions to His Royal Highness the Crown Prince," calls attention to the difficulty of rational control in military leadership He says

" The sensuous impressions which come before us in the course of execution are more vivid than those obtained previously through mature reflection. They are, however, only first appearances of things, and those as we know, seldom correspond exactly with reality We are, therefore, in danger of sacrificing our mature reflection to first appearances.

"Against this we must, therefore, arm ourselves, and place a firm reliance on the results of our own past mature reflections, in order to fortify ourselves by that means against the weakening impressions of the moment

'In this difficulty of execution a great deal depends on that certainty and firmness of our own convictions, on that account, therefore, the study of military history is important, because by it we learn the thing itself, we see the development of events themselves."

Can you recast the above ideas in terms of the problem of strengthening rational control to use as a future guide, which confronts the young man who is fitting himself to become a business executive?

Friction and Resistance.—Upon the difficulties in the way of executing a plan in war, against which decision of character must be matched, von Clausewitz says "Everything is very simple in war, but the simplest thing is difficult . . . Through the influence of an infinity of petty circumstances, which cannot properly be described on paper, things disappoint us, and we fall short of the mark. A powerful iron will overcomes this friction, it crushes the obstacles, but certainly the machine along with them We shall often meet with this result. Friction is the only conception which in a general way corresponds to that which distinguishes real war from war on paper. Theoretically, all sounds very well the commander of a battalion is responsible for the execution of the order given; and as the battalion by its discipline is glued together into one piece, and the chief must be a man of acknowledged zeal, the beam turns on an iron pin with little friction But it is not so in reality, and all that is exaggerated and false in such a conception manifests itself at once in war The battalion always remains composed of a number of men of whom, if chance so wills, the most insignificant is able to occasion delay and even irregularity.

"This enormous friction, which is not concentrated, as in mechanics, at a few points, is therefore everywhere brought into contact with chance, and thus incidents take place upon which it is impossible to calculate As an instance of one such chance take the weather. Here the fog prevents the enemy from being discovered in time, a battery from firing at the right moment, a report from reaching the General; there the rain prevents a battalion from arriving at the right time, because instead of for three it had to march perhaps eight hours the cavalry from charging effectively because it is stuck fast in heavy ground. . . Activity in war is movement in a resistant medium"

To what extent does the conception of friction apply to industry? What various things can an executive do to minimize it and to allow for it?

Administration under Uncertain Conditions.—What methods should an executive follow, and what qualities of mind should he cultivate in himself, when it is necessary to work where there is much uncertainty as to the state of affairs and as to the real factors of the problems involved?

Reference.—Karl von Clausewitz, On War, Book I, Ch III.

Preliminary Preparation.—As a study in the application of the administrative principle of preliminary preparation, present a statement of the manner in which Fridtjof Nansen prepared for his polar expedition in 1893–1896 in the Fram.

Reference—Fridtjof Nansen, Farthest North, N. Y, 1897. Harpers, Vol 1, Ch. II, Preparations and Equipment

Supplement this report by a statement of what actually took place on this expedition See articles "Nansen," and "Polar Regions" in Encyclopaedia Britannica.

Objectifying of Functions.—Mr Frank B. Copley, in his biography of Frederick W. Taylor, N. Y., Harper and Brothers, 1923, Vol I, pp 268–269, gives an account of a system devised by Mr Taylor to insure the proper lubrication of machines. Study this system and deduce the general principle of administration of which it is an illustration Can you give instances of the use of this principle in shop practice, in railway operation, in automobile equipment, or elsewhere?

Non-Financial Incentives.—Mr Robert B Wolf, when Manager of the Spanish River Pulp and Paper Mills of Sault Ste Marie, Ontario, achieved exceptional results in the production of sulphite pulp In his paper, entitled "Non-Financial Incentives," published by the Am Soc of Mech Eng in 1918 (No. 1673), Mr Wolf explains the methods used by him in the management of the men who were in control of the pulp digesters Report as to the methods employed, and frame definitions of the administrative principles employed.

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CHAPTER X

MORALE AND LEADERSHIP

MORALE[1]

In any group of persons, closely associated in an undertaking, there takes place a gradual exchange of ideas and a harmonizing of mood which results in the formation of a common or group attitude. If the final opinion, which is blended out of many contributions, is one of endorsement of the functions and the organization, and there comes into existence a clear conviction of the rightness of everything—the leaders, their aims, and themselves—then a moral force is generated amongst them which expresses the energetic concurrence of their wills. This force is morale It is a manifestation, as it is a measure, of their strength, dependability, pride, confidence, and devotion. It is a philosophy of the group for them an ethical imperative Having reference particularly to war, Professor William E Hocking has framed a definition as follows "Endurance, the initiative, the power of sacrifice, the loyalty, the ability to subordinate personal interest and pride, the power of taking the measure of the event, of discounting the unfavorable turn, of responding to frightfulness with redoubled resolution rather than with fear, of appreciating the real emergency and rising instantly to meet it. It is these qualities of mind and character which, in the ensemble, go by the name of morale "[2]

When a group can endorse its leaders as capable and considerate, its methods as efficient, its policy as fair, and its ultimate aims as something right and worth while—something with a thrill—morale appears. In it everything is summed up: the

[1] This is the French word, pronounced mo-rall'

[2] Morale and Its Enemies, William E. Hocking, New Haven, 1918. Yale Univ. Press, p. 8

administrative organization, the orders, the rewards, the tasks, the leader, and the ranks. This final judgment is a resultant: the sum of all the positives minus the negatives.

The Appraisal of the Leader.—More than anything else, morale is a judgment of the leader. Have his orders been clear and consistent? Has there been an evidence of planning, and of painstaking effort to get the work done in the best manner? Respect for the ability of the leader will not long be given on faith: events must soon prove it to be deserved. The leader will also be judged as to his devotion to the cause. Has he shown respect for other officers, refrained from disparaging remarks about those in higher authority, endeavored to uphold the dignity of the organization, and tried with good-will to carry out the objects set for accomplishment?

With reference to the leader's attitude toward themselves and their welfare the rank and file will watch with anxious scrutiny. Does he take pains to know what they do and suffer? Are there many little incidents which testify to his uncanny way of keeping track of everything that affects them? Is he alert to prevent hardships? Men and women of intelligence do not wish, unnecessarily, to labor under fatigue, nor endure uncomfortable conditions, nor bear exposure. The soldier in an exposed bivouac, the servant on a hard bed in a hot chamber, the factory operative with cold feet on a concrete floor, will brood over the question of the justification. These things can be endured, even cheerfully, if they are necessary to achieve something worth while. It is not that men want ease, but that they want their labors to count. They demand of their leaders, as the price of respect, that their efforts and suffering shall be spent with economy. All the circumstances which throw light upon this matter are of special importance.

If the leader has himself risen from the ranks, the operatives will enjoy telling of his work as a messenger boy or a blacksmith's helper. These stories increase faith that the management understands their point of view. Hence the importance of any actions of the leader, short of abandoning his own proper work, which identify him with the rank and file.

Whether or not Napoleon ever carried the gun of a sleeping sentinel, the story cheered the hearts of thousands of soldiers

That Caesar once seized sword and shield from a soldier and fought in the ranks, as an example to his men, was never forgotten by them. The fact that Philip Armour, after he had become a great Captain of Industry, once stopped in a department of his establishment, took off his coat, and cut meat at the block, meanwhile telling of his early days in Milwaukee, gave rise to a story which influenced all of his men who heard it. When Stonewall Jackson put away the fine uniform presented to him by his officers, and appeared again in the familiar faded and worn suit, he was greeted with cheers and tears by his troops. These things all became symbolical acts: symbolical that the leaders understood the labors of their men.

A conception of the devotion to the welfare of his men, which should characterize a good military leader, is given by Lt.-Col. Lincoln C. Andrews: "A good leader is as one with his men, he speaks their language, he shares their blessings and their hardships, he is jealous of their name, he defends their sensibilities and their rights in the larger organization, in fact he is the recognized guardian of their welfare, physical and mental, as individuals and as a group. He becomes their hero and is affectionately nicknamed. Making camp after a hard march, he will not accept an invitation to lunch while his men go hungry awaiting a delayed wagon; he would not take shelter while his men lay out in a storm. He would be the first to question the fairness of the action of an outsider that seemed to work injustice to his group, or to one of them. If supplies are short, he goes and learns why, and remedies it if possible. He sends an ailing man to the doctor and follows up the case with interest, as would a foot-ball captain follow up the treatment of a member of his team during the season . . . He must be not only a disciplinarian and a psychologist, but something of a doctor, a cook, a tailor, saddler and cobbler, a veterinarian and a blacksmith. He will follow up his men like children, and see that they are properly clothed, fed, rested, entertained, kept in health and spirits, giving freely of his vitality that he may reasonably demand tremendous exertion from them when the opportunity offers."[1]

The Appraisal of Fellow Workers.—A second element in

[1] Fundamentals of Military Service, Lt. Col. Lincoln C. Andrews, Philadelphia, 1916. Lippincott, pp. 20–21.

morale is confidence in fellow workers and in one's self. It is important in factory management that the formation of morale should not be hindered by bringing in persons whose character unfits them for the searching test of a highly socialized form of activity. As we have already noticed, in the discussion of discriminating awards, it is essential for the leader to use every means to strengthen the hands of the loyal and undermine the influence of the disloyal. An employee, who forms a member of a gang with a group task, and has not confidence that others are doing their part, works with divided attention, from the necessity of watching them and he works with restrained energies, from the necessity of regulating his pace to avoid doing their work for them.

Morale is not only a matter of confidence in others, but in one's self as well. This confidence is only to be secured through experience. In spite of all the conceit in the world, everyone has misgivings of himself, until he is put to the actual test "Opportunity," says La Rochefoucauld, "makes us known to others, but more to ourselves" Experience, therefore, of hardships endured together, and of successes achieved together, welds a working force into a moral power Each is proved to the other each knows what he himself can do.

The Appraisal of Aims.—A third element in morale comes from the feeling that the individual task is worth while, and that it is a part of a larger achievement which is worthy to be proud of This has been touched upon in discussing rewards, and also in considering the distribution of information within an organization A business has not only the responsibility to sell its products to the consuming public, and its credit to bankers and investors, but it has to "sell" its jobs to the employees who perform services for it Is there some interesting trick of skill in the work which not everyone can master? Is there a close connection between regularity and the operation of an expensive machine in the next department? Does an omission in an invoice mean that a contractor will be held up on some job for want of an omitted part? Does an error in assembling mean that a child will weep at the edge of the pond, because his skates will not work?

The New England Telephone and Telegraph Company has,

for years, been interpreting in its "Telephone Topics" the significance of the work of the girl at the switchboard They wish her to realize that, at any moment, she may play a leading role in a dramatic episode. The many cases which have been published in full detail reveal the variety of human needs, and the tragedies and comedies of everyday life. In one case at Gleasondale, a telephone is installed in the night, through mud and underbush, for a sick man. In another a woman taken with a hemorrhage in a house alone at night, in Amesbury, mumbles a few words through the telephone and the operator, with the aid of the police, secures assistance. Again it is a man on a farm alone, near Milford, N. H, who breaks his leg in his barn, crawls to the house, knocks off the receiver with a stick, calls for aid: and the operator does the rest. At Amesbury again, in the dead of winter, an operator found a runaway horse and a driver in danger of freezing to death, by calling up all the numbers of several farm lines. At Brockton a supervisor worked for seven hours to locate and get important information to a member of a traveling quartette At Chelsea a telephone was mounted on a board and slipped through a window into the house of a scarlet fever patient A girl who took poison by mistake at Portland was saved with five minutes of leeway. These revelations read month after month have attracted a superior class of persons into the service, and have changed the attitude of the girls at the exchanges toward their work.

The quality of the total achievement aimed at by an organization is shed, in some degree, upon all the tasks which compose it. How important it is, then, that everything in it which possesses the power of appeal should be made known! It is a rule of conduct that everyone desires to link himself with a great cause. Is the project as a whole "something big"? Does it square with what men consider fair and right, so that the employee can "look the world squarely in the face"?

A rule of logic is that the value of things is only revealed when they are stated in terms of their most significant meanings Henry Ford told his salesmen that they were not selling automobiles but transportation. Mr. Houston Lowe, President of Lowe Brothers Company, told his salesmen in convention "First, it is your business to sell. That is understood. But

what is it you are to sell? Why, you are to sell paints, varnishes, and so on Yes, of course. But these things are merely instruments. The fundamental thing is that you are to sell ideas. ideas of beauty, of health, of economy, of prosperity, of service." [1]

Effect of Morale on the Ranks.—Morale is a judgment of comprehensive character. It emerges gradually, as order is seen to succeed order to some purpose, as circumstances at first misunderstood are seen later to have a reason, as with the unfolding of events it is increasingly apparent that a master plan underlies everything, and as success follows success. The resulting confidence is not only a sense of power in use, but of power held in reserve It is the sense of the latter that gives coolness in the face of apparently unsurmountable difficulties. It is success that feeds confidence; and power derives from power. "The difference between a success and a failure," Mr. Arnold Bennett tells us, "is often so slight that a reputation for succeeding will ensure success, and a reputation for failing will ensure failure." [2]

The members of a successful group will have pride in their organization Its name will come to have a challenge. as the Iron Brigade, The Coldstream Guards, The Death's Head Huzzars There may be a mascot: a dog, a monkey, or a donkey,—any symbol, only so that it is ugly enough to make clear that it is not prized for its own sake. Old Abe, the eagle mascot of the Iron Brigade of Wisconsin during the Civil War, was protected with loving care by the men. And when he died, his stuffed body was placed in the capitol building at Madison.

There will be bragging, and stories of achievements for all newcomers. Pride may be so sensitive that any slur will be unsafe. Conduct will be ruled with reference to the honor of the organization: that being condoned which glorifies it (as the practice duels of German student organizations) and that reprobated which disgraces it All tasks become worth while if for the organization, for they become irradiated with a light which is reflected from the esteem in which the organization is held In this way discipline will become self-enforcing. To

[1] Three Things Learned from 50 Years in One Business, Houston Lowe American Magazine, October, 1919

[2] Mental Efficiency, Arnold Bennett, N Y, 1911 G H. Doran Co, p 102

this point General Sherman referred, when he said: "Too many court-martials in any command are evidence of poor discipline and inefficient officers." To an organization with morale, men of spirit will be attracted. It will be possible to grade up with high-class recruits, and so continue high records.

As successes strengthen, so failures weaken. But, as morale is of slow growth, it will not at once be destroyed by hardships and defects. Indeed, a defeat in the popular estimation may be known to those on the inside to be only nominally so. A defeat may be nearly all success. The individual's part in it may have been a success. The defeat may have been due to some incalculable element: a mere buffet of fortune, which men of character must learn to endure. The self-control of the force under stress may have been a triumph. Defeat may be a teacher of an ensuing success, for as Jacob A. Riis said: "Some defeats are merely installments of success." If the failure to win is seen not to be the fault of the leaders, and if it does not extinguish any of the attractions of the aim, morale may be little influenced by it. Such was the morale of the Confederate army under General Lee, during the closing period of the Civil War. Although ragged and barefoot, underfed and out of ammunition, these soldiers protested against the final surrender. Lee lost no particle of their confidence because of reverses and ultimate defeat.

The Effect of Morale on the Leader.—Morale controls the leader in his leadership, for it gives him either a better or a worse instrument. All leaders do chiefly what they can, rather than what they wish. They dare not ask more than their men will do. If an organization be low in its morale, the leader finds that his struggles with apathy, delay, carelessness, forgetfulness, quarreling, recrimination, absenteeism, and covert opposition, wear him down, and leave little strength for the larger aspects of his work. If his motives are everywhere misunderstood, and he is not given the benefit of the doubt, and he can only make good his high turn-over of men with the crooked sticks refused by others, he will fear to put his organization to any real test.

But, if a leader has built up an organization to a high morale; if he has a picked lot, in fit condition, high in spirit, proud of their record, and fast in execution; if he knows that they will vigorously carry out his ideas, and put the best interpretation upon

dubious circumstances,—then a world of possibilities opens before him, and plans become practical expedients which otherwise would be mere dreams. He can now with safety exercise daring, and use a free hand in adopting unusual measures. And so his efficiency is greatly increased, and he can rapidly pile results one upon another. Such a leader we may admire, and of him we may say, "What imagination and what fertility of invention!" It would be more pertinent to say, "What preliminary study to perfect his organization! What consistency in the quiet period of training! What months and years of devotion to his men, to have built up such a power in them that he can use them in this dramatic way!"

Admiral Sims' Rules.—In conclusion upon the subject of morale, we offer the rules formulated for military leaders by Vice-Admiral William S Sims, U. S. N It will be observed that the weight of the counsel hears upon the simple but essential fundamentals of handling human nature

"1 Always let your general mission be understood
2 Invite suggestions and consider them carefully
3 Hold conferences for this purpose
4 Make use of competitions where practicable.
5 Explain the necessity for constant drill
6 Be sure you know thoroughly the subject of all your instructions
7 Encourage your men to come to you for information on any subject, and take pains to look it up and supply it
8 Train your men in initiative by 'putting it up to them,' on all proper occasions
9 When you have inspired loyalty in all your men, more than half your troubles will be over
10 Maintain discipline with the minimum reference to higher authority
11 Always be considerate of inexperience.
12 Be absolutely just in all your dealings with your men
13 Avoid harshness in manner or in methods
14 Never destroy or decrease a man's self-respect by humiliating him before others
15 Do not let the state of your liver influence your attitude toward your men
16 Do not inflict severe reprimands for minor faults.

17 Remember that the purpose of all forms of punishment is correction—correction of the offending individual and a warning to others similarly situated

18 Before you take any action, or adopt any line of conduct, consider carefully its effect upon the man's loyalty, upon the development of his character, and its effect upon the discipline of the organization

19 Remember that every single one of your official acts exerts a certain influence one way or the other

20 Avoid hostile criticism of authority, or even facetious or thoughtless criticism that has no hostile intent." [1]

Leadership

"The slightest study of business conditions will satisfy anyone capable of forming a judgment that the personal equation is the most important factor in a business operation, that the business ability of the man at the head of any business concern, big or little, is usually the factor which fixes the gulf between striking success and hopeless failure" This sentence from President Roosevelt's message to the 57th Congress gives expression to the idea, sufficiently manifest from the discussions of the several preceding chapters of this book, that the work of the executive, and especially that higher form of it which can be designated by the word "Leadership," is a genuine achievement, calling for well-balanced and full-fledged men and women of talent

Stated in a sentence, the functions of the chief executive of a business are, first, to cooperate with the stockholders and directors of his organization in determining what shall be the major objectives of the organization, second, to interpret these general aims into the terms of specific tasks which must be performed by the major departments; third, to select, empower, supervise, counsel, harmonize, stimulate, and appraise the departmental chiefs, keeping ever before them the general plan to which they are contributing

There are presumably as many different kinds of leadership as there are persons in executive positions. Some leaders will

[1] Military Character, Vice-Admiral William S Sims. Journ R. U. S. Institution, Nov , 1917

work with large units ruled by system; others with small units animated by personal loyalty. Some will give wide freedom to subordinates others will measure out narrow portions of authority with exactitude. Some will pull associates by friendship: others will push by the propulsion of punishment. Some will aim at personal gain: others will sink themselves in a common cause. One person cannot successfully use exactly the methods which fit a different personality, in which qualities are present in quite different proportions. The great reliance of all, for guidance upon the highway of leadership, lies in the body of principles which constitutes the backbone of the art of administration These rules represent a calculus of probabilities in dealing with human nature Each individual must learn how to apply them by means of mechanisms and specific policies which are suited to his own personality.

Force of Character.—Many discerning minds have endeavored to construct an adequate description of a certain undefinable something, found in the make-up of an individual here and there, which gives the possessor an advantage in claiming and holding leadership of the personal type. The "eye of command," or weight of personality, or capacity to produce the sensation of mass of power, will be largely the gift of nature. But other qualities, difficult to distinguish from them, may be developed or intensified by experience and confirmed by success Such success may be due to qualities not at all dramatic, nor connected with anything physically imposing, such as persistency, intensity of ambition, concentration, or a steady sense of duty. And yet the results may be written partly on the physical person, in the form of a personal ascendency, a decision of manner, a sternness, a crisp brevity, an atmosphere of confidence, and an expectation of being obeyed, which seem to give an external measure of the power coiled up within the brain.

The natural and the acquired qualities have been blended in Professor William E. Hocking's account of the military leader "If a leader has by persistent study and effort mastered his situation, and he has within himself resolution, an undismayed and undefeatable determination to win, he will through his eye, through his voice, through his gestures, through the substance of what he says, through absorption in his work and belief in his

mission, infuse his own state of mind into his men."[1] Modern science and system have made ample room for persons without these natural endowments, and who by virtue of keen intelligence, capacity for diplomacy, immense industry, or moral force may, indeed, far surpass the possessors of them. But if nature has not given them some commanding physical sign, they will suffer a disadvantage in personal contacts, and will be obliged to prove their way more laboriously.

Power of Decision.—There are two supreme tests of leadership. The first is the possession of the power to make a clear decision. The second is the power to maintain this decision; and to force an organization to follow a consistent line of action. The first of these qualities we shall speak of as decision, or the power of decision; the second as tenacity, or tenacity of purpose

Preliminary to decision is the perfecting of judgment upon the facts. Napoleon once wrote to Josephine, " I have a master without pity, it is the nature of things." Of Wellington, Fortescue said, " The great gift which Wellington possessed was the ability to see things instantly as they were· his great quality was that he never lost his hold on facts, never evaded them, always faced them."[2]

The business executive, like Cromwell, may seek advice, and accept such parts of it as he can assimilate with his own thinking. Wherever disciplinary power is lodged, there will be those near by who have a reason for suppressing or coloring facts. The executive must have the ingenuity to cut his way through any web of silence which may be woven around him. If he is wise he will not be like the prince, of whom Pascal related that he did not hear the truth, because he hated those who told it to him, and visited his displeasure upon them [3] The supreme test of open-mindedness will be the executive's ability to learn the truth from disagreeable sources: to pick it calmly out of an irritating criticism, to discover it in a reprimand, to learn it by comparing himself with some one of whom he has cause to be jealous It

[1] Morale and Its Enemies, William E Hocking, New Haven, 1918. Yale Univ Press, pp 140–141

[2] British Statesmen of the Great War, John W Fortescue, Oxford, 1911 Clarendon Press, p 248

[3] Thoughts, Blaise Pascal, N. Y., 1910. Collier and Son, Ch. III.

pays to put one's self at the point of view of the opposition for all the truth is not always on our side! And it pays to state an opponent's case as strongly as possible to him, as an element of persuasion, for a large part of the enmity in the world comes from the conviction of men that they are not understood by those who oppose them.

Having gathered and digested the facts, and matured opinions, the executive now comes to the heart of his function—the act of deciding upon the course of action to be taken. He must dress away details, force matters up to their principles, concentrate attention, and set his intelligence firmly upon the few crucial determinations which lie at the heart of the matter. All doubt and unclearness cannot be banished from human affairs, but the executive must act even if there is danger, when greater danger lies in inaction. At this point the executive may feel himself a double nature. one consciousness within him holding it shameful to vacillate, and applying the goad to the other which quivers with dread at the thought of possible disaster And so the leader summons his courage for the great resolve, takes the risk, makes the adventure, and coolly, wisely, and deliberately casts the die. In this act, proportionally to the gravity of events, the "strength of soul" is required, of which Napoleon spoke "People rarely have an idea of the strength of soul it requires to deliver, after full reflection on its results, one of those great battles on which depends the fate of an army, or a country, or the possession of a throne And few generals are diligent in seeking battle, although without it no decisive results can be gained."[1]

And now,—having a program—the executive's chief business is to make the action of his organization as strong as possible in it Into this work all his energies should go. To remain pondering over doubts means that his precious nervous force is flowing away without doing useful work His duty is to exterminate doubts, and perfect within himself an invincible clearness and firmness of conviction.

Aids to Decision.—If the circumstances upon which a decision is required appear so diverse and confusing, and so nearly balanced in their pull in a variety of directions, that they cannot

[1] Napoleon, Theo A Dodge, Boston, 1904–07. Houghton Mifflin Co, Vol IV, p 686

be compassed in an act of decision, the executive must take steps to reduce his problem to manageable proportions It is well for him now if he is firmly convinced of the truth that in most affairs the essential matters are few, and usually not difficult to judge One characteristic of great leaders is that matters appear to them simple. They so completely forget details, and so clearly classify considerations into principal and secondary, and so confidently rest upon a few great principles, that their effort seems easy, and their minds appear to be unembarrassed. This is a great marvel to the inferior mind, which cannot evaluate so clearly, and which, therefore, is burdened with a multiplicity of considerations, all of which seem equally vital.

The object of the leader in gathering information on any proposition is not to collect every conceivable fact pertaining to it, but to get a sufficient grasp of a few really vital matters The leader should be intelligent, but not too nimble nor imaginative in exploring every minor difficulty. Mr. John H. Williams has said bluntly. "I remember as a boy wondering why so many seemingly stupid men are successful. I know now it is because although they see only one thing, they see it clearly and prosecute it aggressively Singlemindedness has made more men than it has ruined "[1]

More in detail, Von der Goltz explains the vice contrasted with singlemindedness. "Highly intellectual natures readily adopt a universal theory, which is prejudicial to successes within the narrow sphere of active service They penetrate too deeply, as a rule, into the true nature of things, and discern more sharply than others risks and dangers. Then follows doubt, that destroyer of self-confidence and that arch-foe of all success. . . . Frederick was right in peremptorily forbidding his generals to hold a council of war. That clever discerner of men knew full well that the only result ever gained thereby is a majority for the 'timid party' The intelligence concentrated in a council of war is wont to be productive of no other advantage but this—that there all the weak points of an army are carefully brought out, and proofs adduced to show how dangerous all action in the

[1] Policies and Methods of the Chief Executive, John H Williams, Bulletin Taylor Society, April, 1923, Vol 8, pp 53–58 Also in The Modern Executive, Daniel Bloomfield, N Y, 1924 Wilson, pp 71–85.

field is By this, the will of the general becomes only still more disquieted and weakened; and a 'council of war' has become an ominous word, the sound of which, as a rule, is equivalent to capitulation or defeat "[1]

A second aid to decision is to have a firm grasp upon the principles of organization and administration, and especially upon that part of them which interprets the operations of human nature in the mass. This will come from the interpretation of one's own experience, and from the study of the methods of the great leaders of the past in statecraft, war, diplomacy, and business. Observation should be directed chiefly to discover strength rather than weakness. One should study the sources of power—the virtues, the things which move and control ideas, the positive rather than the negative side of things—realizing that all things exist by reason of their virtues rather than their faults.

A third aid to decision is to keep the proposed program as simple as possible Not too large a program should be proposed, which will strain the resources available. Not too many different lines of effort, so that one must be continually changing work and losing momentum, and laboring with the hasty preparation characteristic of scattered aims. Nor should the proposed program be so intricate, and depend upon such exact coordination of parts, and such nice adjustments of time, that unusual intelligence and experience are required to achieve it, and any slight miscalculation or delay or failure of a part will wreck the whole enterprise. Nor should the attempt be made to project a plan so far into the future that the calculation becomes largely guesswork

Anything which works economy of nervous energy will promote sufficiency at the point of decision If the leader have a well-trained will, able flexibly to turn without anger or aversion to any necessary task, inner friction will be reduced. If there has been cultivated incisiveness of thinking and conciseness of speech, the leader will have the habit of going straight to the heart of things, and he will have a mind stored with clear, usable knowledge. If the proposed policy be one of vigorous initiative, it will be simpler and more coherent, and more easily planned for,

[1] The Nation in Arms, Freiherr von der Goltz, London, 1914 Hodder and Stoughton, pp. 48–49

than one of resting passive and responding to the chance development of outside forces. Promptness economizes nervous energy

It will be an aid to decision if the executive be experienced in testing the soundness of his ideas. One test of soundness is clearness and distinctness: another is constancy of conviction through varying moods: still another is like valuation in other normal minds. The pragmatic test of ideas is: have they worked, and do they work? It will also prove an aid to decision if the leader understands that complex judgments are best matured in the subconscious mind, rather than artificially fabricated as the result of a process of conscious reasoning When the mind is properly charged with clear ideas, the filaments of brain tissue, in a hidden and mysterious process, make innumerable couplings, and at last send through into consciousness an opinion. The act of decision is, strictly speaking, not an act of judgment, but the act of deciding to adopt one's judgment, as the rule of action.

Finally, whatever will aid the leader to attain a degree of confidence in himself, appropriate to what he can justify in action, will strengthen in him the spirit of resolve The philosopher Nietzsche, states the need of self-confidence. "In general, few men have belief in themselves· and of those few some are endowed with it as a useful blindness or partial obscuration of intellect. The others must first acquire the belief for themselves: everything good, clever, or great that they do, is first of all an argument against the sceptic that dwells in them: the question is how to convince or persuade this sceptic, and for that purpose genius almost is needed."[1] Hence the value of success, and the wisdom of concentration of energies sufficient to secure it.

Tenacity of Purpose.—The second test of a leader is his tenacity of purpose in putting through his program in spite of all opposition and discouragement, short of that which would clearly foredoom it to failure. When a leader has made his decision, and has inaugurated his plan, he is not released from anxiety In fact he may enter upon a program of anxieties. All action is in a resistant medium: all forward movement is accompanied by friction. Energy must constantly be poured in· and from it there will be subtractions for delay, misunderstanding, ignorance,

[1] The Joyful Wisdom, Friedrich Nietzsche, Ch IV.

and accidents. The resultants of the forces, when many persons are involved, can never be calculated far in advance, and never calculated with exactitude. As Paley has said, "A common misunderstanding is that authority is pleasant and submission painful. It would be nearer the truth to say, 'Command is anxiety: obedience is ease.'"

Of the strength of character required for leadership in war, von Clausewitz gives us an idea, "That the conduct of war is very difficult is a matter of no doubt; but the difficulty is not that special learning, or great genius, is required to comprehend the true principles of conducting war; that can be done by any well-organized head, with a mind free from prejudice, and not altogether ignorant of the subject.

"The great difficulty is to adhere steadfastly in execution to the principles which we have adopted

"The whole conduct of war is like the action of a complicated machine, with an immense amount of friction; so that combinations which are easily made on paper can only be carried into execution by very great exertion.

"Therefore the free will, the mind of the general, finds itself impeded in its action at every instant, and it requires a peculiar strength of mind and understanding to overcome this resistance By this friction, many a good idea is lost, and we are obliged to lay down a plain, simple scheme, when by a somewhat more complicated one greater results might be attained"

Again, of leadership in war, which has points of similarity with leadership in industry, von Clausewitz says: "In war, more than anywhere else in the world, things happen differently from what we had expected, and look differently when near from what they did at a distance. With what serenity the architect can watch his work gradually rising and growing into his plan! The doctor, although much more at the mercy of mysterious agencies and chances than the architect, still knows enough of the forms and effects of his means. In war, on the other hand, the Commander of an immense whole finds himself in a constant whirlpool of false and true information, of mistakes committed through fear, through negligence, through precipitation, of contraventions of his authority, either from mistaken or correct motives, from ill will, true or false sense of duty, indolence or exhaustion, of acci-

dents which no mortal could have foreseen. In short, he is the victim of a hundred thousand impressions, of which the most have an intimidating, the fewest an encouraging tendency. By long experience in war, the tact is acquired of readily appreciating the value of these incidents: high courage and stability of character stand proof against them, as the rock resists the beating of the waves. He who would yield to these impressions would never carry out an undertaking and on that account *perseverance* in the proposed object, as long as there is no decided reason against it, is a most necessary counterpoise Further, there is hardly any celebrated enterprise in war which was not achieved by endless exertion, pains, and privations, and as here the weakness of the physical and moral man is ever disposed to yield, only an immense force of will, which manifests itself in perseverance admired by present and future generations, can conduct us to our goal."[1]

And if the leader listens to a multitude of counselors, so that to the testimony of his own fears there are added the predictions of disaster made by others, and the suggestions of associates for remodeling his program, the situation may become desperate indeed Von Moltke testified to this "But surround a commander with a number of independent men—the more numerous, the more distinguished, the abler they are and the worse it will be—let him hear the advice now of one, now of another, let him carry out up to a certain point a measure judicious in itself, then adopt a still more judicious but different plan, and then be convinced by the thoroughly sound objections of a third adviser and the remedial suggestions of a fourth,—it is a hundred to one that though for each of his measures excellent reasons can be given, he will lose the campaign."[2]

But, it may be asked, should not the leader be open-minded? Openmindedness is a virtue the conception of which is chiefly fixed for us by the experience of those engaged in philosophical speculation and in scientific research For such persons, the

[1] On War, General Karl von Clausewitz, London, 1911 Paul, Trench, Trubner & Co, Vol I, Book III, Ch VII, pp 191–192, and Appendix Instruction to His Royal Highness the Crown Prince, Vol III, p 222

[2] Moltke's Militarische Werke, Gruppe III, 3 Teil, quoted by Spencer Wilkinson in "The Brain of an Army," London, 1890. Macmillan

abandonment of an hypothesis for something nearer to the truth is always in order. But an executive is in an entirely different position When a plan is under way he has entered upon a series of dependent sequences, to break which means to lose a large part of the investment of energy and property which has gone into the making of the preceding steps. For him a change of plan to fit new facts has the significance of the popular phrase, "Changing horses in the middle of the stream." To change a plan after it is once under way is to incur a certain loss, the threatened difficulties which suggest it may never materialize. It is the business of the leader, by thoroughly forecasting the situation before the initial decision, and by the determined prosecution of the plan, to make the occasions for changing the plan very few indeed.

In the main the path of wisdom is to adhere to the judgments which were formed when the mind was clear and at ease. This rule von Clausewitz refers to as a maxim "That maxim is, in all doubtful cases to adhere to the first opinion, and not to give up until a clear conviction forces us to do so "[1]

Great leaders have always displayed tenacity in maintaining their decisions Lord Kitchener was described as of "unwavering determination" and "adamantine certainty" Cecil Rhodes was credited with "indomitable spirit and perseverance" Wellington has been coupled with Cromwell and George Washington as "of spare and meager imagination and gigantic common sense"

Aids to Tenacity.—Much that has been said with reference to decision will apply in aiding the leader to resist the encroachments of fatigue, apprehension, and distracting advice. Whatever works an economy of nervous energy will give him poise to steer the precarious middle course between adaptability and consistency, between pliability and stubbornness All personal antagonisms should be avoided. Quarreling men are men who are not busy enough. Those who are devoted to a cause crave the cooperation of all good men, and so rise above envy. As Lord Nelson said at Cadiz to Admirals Collingwood and Rotherham, pointing to the Spanish fleet, "Yonder are the enemy."

[1] On War, General Karl von Clausewitz, London, 1911, Paul, Trench, Trubner & Co , Vol I, Bk I, Ch III

The leader will avoid any sort of double dealing, either with his associates or with the rank and file. Pretense makes a severe tax upon ingenuity, first, from those who erect it to screen themselves and, second, from those who strip it off. Employees perceive very shrewdly what are the guiding principles of the organization of which they form a part. And they are seldom deceived as to what their employers really put first in importance, and what they put last. If some mystery is made of this, the entire organization will resolve itself into a conspiracy to piece together incidents and remarks until the truth is known. All false dealing is futile; and it is absolutely destructive of loyalty.

The leader must seek for the cooperation of others, for it is only through the strength of his organization in performing, that his anxiety as to his plans can be lessened. The power of an organization is the result of its constructive and aggressive forces minus its resisting forces. When the administrator feels himself to be the sole driving agency, and finds himself chiefly engaged in arousing those who are apathetic and coercing those who are antagonistic, there is something vitally wrong with the administration An executive should find himself engaged chiefly in directing the energies which create themselves naturally in all parts of the business, and in finding the proper outlet for the eager upward striving of the ranks below.

Problems

The Adjustment of Talent to Task.—In a small shop there are five positions, and there are five men to be assigned to them. The importance of the tasks has been indicated by a scale of numbers. The estimated fitness of the five men for each of the tasks has been expressed in a scale of percentages. These valuations are given in the table below In this table the tasks are designated by numbers, and the men by letters. Indicate which man should be assigned to each task, and formulate the principle you have used

Authority and Responsibility.—Summarize into a compact code the rules or principles which can be laid down to govern the distribution of authority and responsibility as between the different officers of an organization.

Reference Ch 7 of the text.

Ostracism.—Report upon the practice of ostracism as employed by the Greek states, especially Athens. What was the purpose of the

Task No	Relative Importance of the Tasks	Fitness of the Men for Each Task				
		A	B	C	D	E
1	100	70	85	80	90	100
2	90	80	60	80	91	90
3	80	85	95	40	92	88
4	60	88	50	65	95	85
5	50	90	70	82	80	82

institution, and what justification of it, administratively, can be urged? See Ferguson, Greek Imperialism, pp 60–61, Encyclopaedia articles, etc

Administration and The Spanish-American War—Read the account of the transfer of American troops from the United States to Cuba, during the Spanish-American War, as given by Theodore Roosevelt in "The Rough Riders," N Y, 1899, pp 47–71, and point out the principles of efficiency which were violated

Promotion Plans.—If it is desired to adopt a comprehensive system of promotion in an establishment, how will the following questions be answered "What becomes of the workers who find exactly the positions which suit them, and who have no desire to advance?" "If promotion is generally applied, will not men be promoted or graduated out of the organization?" "What becomes of such well-known blind alley jobs as that of elevator or errand boy?"

The American Ward Boss.—The American ward boss has received many condemnations at the hands of political reformers, but he, as an institution, continues to persist What are the sources of his influence? What can be said in his defense as a social factor and as a manager?

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See further the bibliographies attached to Chapters VII, VIII, and IX.

CHAPTER XI

SCIENTIFIC MANAGEMENT

In the later seventies and the eighties there were many executives, in eastern manufacturing institutions largely having to do with metal working and the construction of machinery, who, on account of their engineering training, began to look upon the problems of production, and of management generally, as matters which could be investigated in a scientific manner and controlled by the standards which such investigations might reveal These men were connected with establishments of more than average progressiveness, they were confronted with a process of production of impressive character, and they worked in a period when stimulating discoveries were being made in metallurgical chemistry

Among these men, including disciples with pioneers, may be mentioned. Henry R. Towne, Frederick W. Taylor, Carl G. Barth, Henry L Gantt, Horace K. Hathaway, Morris L Cooke, Harrington Emerson, Frank B. Gilbreth, James M. Dodge, Henry P Kendall, Dwight V Merrick, Sanford E. Thompson, and Richard A. Feiss These men, not only by their actual achievements in industrial organization and operation, but by their facts and opinions communicated orally as well as through their writings, launched a body of ideas, which gathered headway slowly through three decades from 1880 to 1910, and in the latter year in connection with the railway rate hearings of the eastern railroads, became the most talked-of development of American industry, dividing opinion into support and opposition, and developing as a subject of public interest similar to the conservation movement

Frederick W. Taylor.—The central personality of this movement was Frederick W. Taylor (1856–1915). A man of superior ancestry and exceptional upbringing, he had, for a person with

such a background, the unusual experience of working as an apprentice and then as a journeyman in a machine shop, and of passing through a long grim fight as a foreman and superintendent in the endeavor to secure what he considered to be a fair quantity of output. Gifted by nature with an inquiring mind and an unusually hard-headed adherence to fact, he possessed enthusiasm and a consuming zeal and earnestness, as of one who sees the ideal.

This thorough-going realist carried on, with tremendous tenacity of purpose, throughout the greater part of his industrial life, in addition to the responsibilities of current affairs, a series of investigations of exceptionally thorough and scientific nature The results of these he had the force of character to bring to application in the control of operations, although the effort to do so was revolutionary, and encountered general indifference, misunderstanding, and opposition. Retiring from business in 1901, during the last fifteen years of his life, his energy and his means were devoted almost entirely to the development of the conceptions of scientific management, and to the propagation of the ideals through which he hoped that a new industrial day would dawn and particularly for the rank-and-file of the wage-earning classes.

Conditions Found.—It may throw the contributions into sharper perspective if we suggest the background of industrial conditions which Taylor, and his immediate disciples, Barth, Gantt, Hathaway and Cooke, as well as Harrington Emerson, Frank B Gilbreth, and other leaders, encountered at the beginning of their labors.

"Very few of those who have not made special investigations," says Harrington Emerson, "realize how very low the average efficiency of endeavor is, even in a highly civilized country like the United States. Everywhere we see brilliant results, rarely can any one follow the losses between result and initial supply.

"Not only are recurring wastes more flagrant than is generally admitted, but it is also not realized that very hard and extremely exhausting work is not an evidence of efficiency. It is not because men do not work hard, but because they are poorly directed and work under adverse conditions, that their efficiency is low. . . .

"Railroad repair shops throughout the country do not show 50 per cent efficiency on an average as regards either materials or labor.

"In a big locomotive shop, a careful study of the machines which had been in operation for twenty years showed that the location of 75 per cent of them would have to be changed, so as to facilitate the orderly, effective, and economical progress of work from one to the other. This and other eliminations of wastes doubled the output, with less labor costs.

"Coal wastes on railroads are almost as bad as labor and material wastes. On a very large railroad system, the fuel charged per 1000 tons of train weight per mile averaged 260 pounds; yet actual tests where all coal used was weighed showed a consumption between terminals of only 90 pounds. This actual consumption could be doubled, be made 180 pounds, yet this standard be only 60 per cent of the coal paid for. . .

"Mr Taylor found a labor efficiency of only 28 per cent in the rough labor employed in the Bethlehem Steel Company's yards. The writer, by time studies, determined an efficiency of only 18 per cent in a gang of laborers excavating a foundation, and even less on some construction work in the erection of the large office buildings in New York.

"Inefficiency is not a local evil It extends through the whole of American life—extends through the whole industrial life of the world."[1]

At Cramp's shipyard in Philadelphia an apprentice reported the policy of the mechanic with whom he worked. "If he could not see a month's work ahead providing a reasonable factor of safety, we did not slow up—we *stopped*" At the Brooklyn Navy Yard there were five separate paint shops, five machine shops, and five carpenter shops, all run independently, because the various bureaus represented in the yard would not consolidate similar operations. At the plant of the Midvale Steel Company a large increase of production was brought about in metal cutting by directing a stream of water onto the point of the tool. This improvement was introduced in 1884; and, although the works were at all times open to visiting manufacturers, no other metal

[1] Efficiency as a Basis for Operation and Wages, Harrington Emerson, N Y, 1909 The Eng Mag Co, pp 15–24

cutting establishment had the enterprise to copy the idea for fifteen years, or until 1899 Even the manufacturers of metal cutting machinery did not know at what speeds, nor with what feeds and depths of cut to operate their own products

The pioneers of whom we have spoken, and many others working toward similar methods in other lines of industry, found: (*a*) that current performance and the methods prescribed by craft and tradition were crude and wasteful, (*b*) that much of the tools and apparatus used was but indifferently fitted to its purpose; (*c*) that workmen were everywhere performing tasks for which they were not fitted, and for the most part without knowing it (the task being accommodatingly small), or knowing for what they were fitted; (*d*) that no one, whether workman or manager, knew the time a given piece of work should take, nor how much a first-class man ought to be able to do in a day, (*e*) that the conditions under which work was done had never been brought under sufficient control to be able to determine steadily whether failure to perform tasks was due to the workman or to some one of the conditions over which he had no authority; (*f*) that for the most part managers were not awake to their responsibility for the many delays and vexations with which employees daily contended, and which arose from unstandardized conditions.

For a period of thirty years this group of men, most of whom were leaders in their profession, worked at available times upon these problems. Their general conclusions were that, in comparison with what is possible with scientific control, the industries of the country were working at about 50 per cent efficiency.[1] In view of the self-satisfaction which at the time of the publication of these reports marked most public utterances concerning American industrial achievements, the independence of this conclusion is striking It is interesting to observe that these conclusions growing out of the study of shop processes were confirmed within a short time by independent investigations into the national methods of handling natural resources, by studies of the waste of mercantile distribution, by the reports of engineers concerning

[1] Hearings Before the Special Committee of the House of Representatives on The Taylor and Other Systems of Shop Management, Vol III, pp 1389 and 1734 See also The Iron Age for Jan 9, 1913, for conditions at the Watertown Arsenal

railroad operations, and by the conclusions of psychologists as to the low plane of efficiency upon which most men are contented to live

Brief Statement.—With the endeavor to give to the results of this great movement a favorable interpretation, and considering not only past accomplishments but the ideals of the chief promoters, scientific management may be defined and described somewhat as follows. It is a body of rules, together with their appropriate expression in physical and administrative mechanisms and specialized executives, to be operated in coordination as a system for the achievement of a new strictness in the control of the processes of production. As this system invites the cooperation of the workman, it develops a further exact and refined technique for the analysis of human operations, and the synthesis of elements into standard tasks, together with a system of rewards based upon individual performance.

By means of its corps of specialists it provides trained minds for attaining a higher degree of excellence in all branches of shop management than has been possible before. It improves and holds to standard such things as equipment, belting, tools, materials, working conditions, and methods of working. And it more or less completely revolutionizes and improves layout, routing, scheduling, nomenclature, purchasing, stockkeeping, and accounting. By virtue of a new closeness in the correlation of the agencies of control it attains a degree of dependability of operation which protects against delays, mistakes, accidents, and neglect; while its promptness provides timely instruction, constant guidance, immediate goals, and prompt rewards. Its search for fact and principle tends to eliminate arbitrary rule, and its closely interlocking personnel of specialists lessens the area of individual dictation. Furthermore, immediate and full records provide publicity, and constitute a sort of court of reason

In so far as exact knowledge displaces custom, guesswork, and arbitrary exaction, it defends the worker against soldiering and sloth, or over-speeding and fatigue. The high task standards characteristic of it automatically sort workers to the levels of their best occupations, while at the same time all are educated and energized. By adherence to high standards of performance throughout, for management and men alike, it becomes a possible

agency for raising wages, shortening hours, increasing profits and lessening prices to consumers.

Finally, as a section of economic thinking, scientific management is a new emphasis on, and reliance upon, the application of the scientific method of analysis to the factors of production, sustained by the belief that through an increase of production alone can greater prosperity be achieved for all classes, so that through the promotion of such an increase the interests of labor and capital may be harmonized.

Professor R. F. Hoxie, who was meticulous in his chronicling of the deficiencies and defects of the system, has thus defined the essential idea of scientific management. "Theoretically, scientific management is an attempt through accurate industrial analysis to discover and put into operation the objective facts and laws which underlie true efficiency in production. In its broadest and best application it attempts through this process of analysis to determine the best location and structure of the shop for the particular manufacture designed; the most efficient processes and methods of production in general and in detail; the material, organic and human arrangements and relationships best suited to further the productive process; the most effective character, arrangement and uses of the machinery, tools and materials employed; the methods of selection and training of the workmen and managerial force most conducive to efficiency; the character and amount of work which can and ought to be performed by each member of the labor and managerial force; the payment to be accorded each individual in the interests of efficiency and justice, and in general it aims to discover all the material organic and human qualities, arrangements and relationships which will result in greatest output and lowest cost."[1]

Standardization of Working Conditions.—The improvement and standardization of all equipment and services of which the worker avails himself in performing his tasks is logically the first half of scientific management, as it is historically the first portion of it to be developed. Early in his career at the Midvale Steel plant, Taylor began to carry on experiments with a view to discovering better ways of working. In these experiments

[1] Trade Unionism in the United States, R. F. Hoxie, N Y, 1917. Appleton, pp. 326–327.

it was necessary to keep the experimental machine in standard condition, to have the belt in perfect tension, to control the material, temper, angles, etc., of the tool, to keep the materials worked upon uniform, and to use an employee who could be depended on to carry out the methods prescribed. If all conditions were not held constant, except the one which was the variable under observation, it would be impossible to interpret the results.

In endeavoring to apply the results of experiments to the regular work of the shop, the idea at once suggested itself that the shop in its turn must similarly be kept in reliable condition, more or less as a laboratory for work, if the results calculated upon were to be secured. It will be readily understood that if a workman is given a task to perform in a given time, let us say, on a machine, but if the machine is out of repair, or the belts do not convey the necessary power to attain the prescribed machine speeds, or the tools are dull or lost, or the materials are defective, or no foreman is at hand to give necessary instructions, such a workman cannot be held responsible for the failure.

The workman cannot maintain his standards unless the management maintains theirs. The failure is not his; it is a failure of management. To bring under control all these factors and many others, and isolate the variables representing the workman, the pioneers of scientific management set themselves to organize some new agencies.

As investigations revealed that the factors determining the efficiency of even so-called simple forms of work were complex, it was realized that it was beyond the power of operatives, untrained in research, to analyze them. The full responsibility for the study of them, and for bringing them under rational control must, of necessity, fall upon the management. And so there developed the further idea, which Taylor more and more emphasized as time went on, that intelligent production can only take place where managements are willing to assume a great variety of new duties. To this new work of management, rather than to the extra exertion of the workers, he attributed the productivity of the new methods. Mr. Carl G. Barth thus put the matter: "Practically all my work and all the time study work

of Mr. Merrick . . . has been connected with all-'round machine shop work, in which the time of machining a piece of work sometimes exceeds by many times the time the operator applies himself directly.

"With us, therefore, it has so far been more a matter of the study of the possibilities of the machine and the surrounding conditions that are independent of the particular operator, than of the operator himself.

"Our gains have consequently come more from the re-speeding and often re-building of machines, the institution of improved tool rooms, and so forth, than from the subsequent time studies made of the manual operations involved."[1] In the metal cutting trades the equipment is unusually complex and expensive, and it sets the pace for the greater part of the productive process We can understand, therefore, that Mr. Barth's experience would not necessarily hold for different types of industry.

The experiments of the pioneers of scientific management showed them, by many bitter experiences and humiliating defeats, that the preliminary standardization of the shop must be thoroughly done Says one of the engineers engaged in installation, "After every fall down, you pick the system up by the scruff of its neck, give it a kick, and it goes on again. And so it continues until one fine day, lo and behold! it proceeds as if by a miracle to work and keep on working of its own accord."[2] At last all the elements are functioning under full control; each performing its part like an organ in the body. Taylor advised one or two years of preliminary standardization before attempting time studies of workmen.

Order of Steps.—Mr. H. K. Hathaway[3] has suggested that the steps in the installation of scientific management may be taken somewhat in the following order

[1] Stop Watch Time Study. An Indictment and a Defense, Symposium in which the chief participants were Barth, Merrick, Spaeth and F B and L M Gilbreth Bulletin of the Taylor Society, Vol 6, No 3, June, 1921, pp 99–135

[2] Frederick W Taylor, Frank B Copley, N Y Harper and Brothers, 1923, Vol II, p 183

[3] Logical Steps in Installing the Taylor System of Management, H K Hathaway, Industrial Management, August, 1920, pp 93–95.

(1) Perfect the general plan of administrative organization of the departments

(2) Carry through a plan of physical rearrangement of departments, with the relocation of equipment

(3) Collect and codify all information needed by the making departments with reference to the company's products.

(4) Collect and classify information relating to machinery and equipment

(5) Standardize the machinery and develop an adequate system for maintenance

(6) Standardize tools and establish a tool room and a system of tool conditioning and tool accounting

(7) Install a stock room and open a system of stock accounting

(8) Develop and standardize work orders

(9) Perfect the time-keeping system

(10) Establish the routing and order-of-work for all manufacturing operations

(11) Install agencies for follow-up and the control of work in process

(12) Make time studies, choose the most efficient movements of working, and develop an adequate wage system.

(13) Adapt the cost accounting system to the new requirements

Preliminary Improvements.—While scientific management is a flexible system, which can be fitted to a variety of individual situations, it is only logical to cure any manifest deficiencies which may exist in an establishment before installing it There are several lines of preliminary study and improvement which will be necessary One of these has to do with the general administrative organization, the subdivision of departments, and the partition of responsibilities between officers. When executive practice has been settled it should be reduced to written form in a book of standing orders Another inquiry concerns the physical layout of operating departments and the proper coordination of their productive capacity. Layout is not to be confused with scheduling It is related to job scheduling much as the location and construction of a line of railway is related to the scheduling of trains over it A third department of study deals with the company's products. It aims to accumulate in the planning room all drawings, specifications, and samples necessary for the guidance of manufacturing Incidentally

there may be suggested, during the course of this investigation, various improvements in design or material which will facilitate manufacture. A fourth inquiry is directed to machinery and equipment and will aim to install what is necessary to do the work implied by the company's products. For each machine or work place the planning department must have information as to speed, adjustments, and size of work that can be handled, so that operation scan be assigned with assurance. A portion of this work will be the standardization of belts and the development of a system of inspection and repair to insure proper tension and to prevent breakdowns. Taylor early gave attention to belts, because of trouble encountered at the Midvale Steel plant with the experimental boring mill upon which metal cutting investigations were carried on.

The System of Control

The control of manufacturing operations upon the basis of the preliminary standardization just described begins with the analysis of what is required to satisfy customers' orders. The chief element is the control of the schedule of operations. This involves the determination of the speed at which machines shall be operated, the speed at which employees shall work, and the order in which tasks shall succeed one another. The order of tasks divides itself into two problems. The first, spoken of as "routing," is to determine the sequence of the operations which are comprised in a single manufacturing order. The second, denominated "order-of-work," is to determine in what sequence manufacturing orders shall be permitted to follow each other through the shops. The combination of the two completes the control of priority of functions. The remaining aims of manufacturing control are to insure the necessary supply of materials, tools, and instructions at the work place as the job starts, to follow up effectively to see that the schedule and the quality standards are observed and, at the conclusion of the task, to make the necessary reports and returns for scheduling, stock record, tool account, pay roll and cost purposes.

Such control as this implies is easily maintained for continuous-process industries, like flour milling and paper manufacturing. It is not difficult for establishments which manufacture con-

tinuously a single discreet product, or which manufacture a small variety of simple articles in large lots. When, however, we turn to establishments of an engineering nature which make, rather than manufacture, a variety of complex products, either singly or in small lots, on customer's orders, the problem of control becomes complex. It was in connection with the latter class of industries that the mechanisms of scientific management were first developed The methods appropriate for such cases have come to be considered the standard form, from which to derive any simpler system which may be desired

Machine Speeding.—The determination of the proper speed for all power-impelled mechanisms, and the designation of the adjustments which should be made in any mechanism (in the case of metal-cutting this would involve speeds, feeds, and depth of cut), so that it shall work at its maximum capacity, is a matter for engineers and operating experts. It involves a thorough mastery of the engineering subject of stress and resistance as it is involved in machine design, an understanding of the physics or chemistry of the manufacturing process (for example, the laws of metal cutting and the properties of tool steels), and the mathematical ability to construct the Barth type of slide rules for the solving of problems containing a large number of variables. In the case of the metal-cutting trades, with which Taylor had chiefly to do, the problem of machine speeding proved to be an enormously complex one.

The history of this investigation, in which Taylor, Sinclair, Barth, Gantt, and many others, were involved for a series of years, is given by Mr. Taylor as follows: "In 1881, in the machine shop of the Midvale Steel Company, the writer began a systematic study, by devoting the entire time of a large vertical boring mill to this work, with special arrangements for varying the drive so as to obtain any desired speed. The needed uniformity of the metal was obtained by using large locomotive tires of known chemical composition, physical properties, and hardness, weighing from 1500 to 2000 pounds. For the greater part of the succeeding twenty-two years these experiments were carried on, first at Midvale, and later in several other shops, under the general direction of the writer, by his friends and assistants, six machines having been at various times especially

fitted up for this purpose. The exact determination of these laws and their reduction to formulae have proved a slow but most interesting problem."

We may pause to remark that the accurate fixing of the variables involved, and so the final setting of the most profitable speed in metal cutting, is a problem which could by no possibility have been solved by the mechanic unfamiliar with higher mathematics, through the use of ordinary experience; nor could it have been transmitted from one workman to another as a rule of thumb or craft tradition. The variables entering into the case have been enumerated by Mr. Barth as:

(1) The size and shape of the tools to be used
(2) The use or not of a cooling agent on the tool
(3) The number of tools to be used at the same time
(4) The length of time the tools are required to stand up to the work (life of the tool)
(5) The hardness of the material to be turned.
(6) The diameter of the material or work.
(7) The depth of the cut to be taken
(8) The feed to be used
(9) The cutting speed
(10) The cutting pressure on the tool
(11) The speed combination to be used to give at the same time the proper cutting speed and the pressure required to take the cut, and,
(12) The stiffness of the work.

To return to Mr. Taylor's recital of the history of the experiment, he says. "By far the most difficult undertaking has been the development of the methods and finally the appliances (*i e*, slide rules) for making practical use of these laws after they were discovered. The difficulty, from a mathematical standpoint, of obtaining a rapid and accurate solution of this problem will be appreciated when it is remembered that twelve independent variables enter into each problem, and that a change in any of these will affect the answer.

"It was not until 1900, in the works of the Bethlehem Steel Company, that Mr. Carl G. Barth, with the assistance of Mr. Gantt, and a small amount of help from the writer, succeeded in developing a slide rule by means of which the entire

problem can be accurately and quickly solved by any mechanic."[1]

It is necessary to design a slide rule for each type of machine on the basis of the number of tools to be used, the cooling device, the attainable speeds, and the power of the machine to resist stresses. When, further, there has been a proper standardization of the size and shape and material of the tools, and of the depth of cuts for given classes of work; and after allowance has been made for the hardness of the material, and the stiffness of the work, it is possible to sift the problem down to a few combinations of speed, feed, and life of tool. Choosing the most efficient combinations, special slide rules can be prepared to indicate quickly what pulley and cone combinations must be used to drive the tool at the indicated speed on work of a given diameter.

The Routing Function.—When the officer in charge of routing calculations receives, from the proper authority, a manufacturing order to prepare, in case it calls for a complex product formed by the assembly of parts, he proceeds to analyze it into its elements, to determine which parts or materials are to be purchased, which to be taken from stock, and which manufactured. For purchased articles requisitions addressed to the purchasing officer are prepared. For materials or parts from stock, stock orders are prepared. For such parts as are to be manufactured, it has first to be considered whether the quantities desired can be put through the shops as one order, or should be broken up into batches. This decided, the routing officer proceeds to determine the number, variety, and sequence of the manufacturing operations which will be required. He aims to separate operations in such a way that unskilled men can be used for the less particular parts, while skilled men are saved for the difficult work. It is next decided what machines or work places are to be used for each operation. As far as choice is possible, and balance of work will permit, the least expensive equipment is engaged which will do the work.

To assist himself in his calculations the routing officer prepares a chart or route sheet. On this, by means of a diagrammatic

[1] Shop Management, Frederick W. Taylor, N. Y. Harper & Brothers, 1911, pp. 179–180.

arrangement, he indicates how the raw materials pass into parts, how the parts are taken up into minor assemblies, and how the minor assemblies in turn pass into the final assembly Upon this sheet he indicates, for his convenience, the names or symbols of materials, parts, and assemblies, the names or symbols of processes, and the names or symbols of the best suited (or several well suited) machines or work places. To bring the component parts of each assembly together simultaneously, he figures back from the date fixed for the assembly, allowing for the length of each chain of operations, to the dates at which work on the different elements must be started.

The routing officer prepares and holds all necessary orders for stock or stores, all move orders which will be required to authorize move men to convey work from one work place to another, and all time cards for workmen, which will be necessary for recording their time for pay roll and cost purposes. He cooperates with the time study and instruction card clerk in the preparation of such instruction cards as will be required, designating upon them the machine or work place assigned, and the quantities and kinds of material to be provided. This document, completed by the time study and instruction card clerk, serves as a guide to the gang boss in assembling everything which must be brought to the worker while he is yet engaged upon the next preceding piece of work. It then serves to guide the worker. The routing officer prepares all inspection orders necessary properly to advise the shop inspector of the starting of a new piece of work, so that he may give whatever instruction or demonstration may be necessary, may inspect the first pieces produced, and may otherwise safeguard standards of quality. All these documents are assembled and kept together, pending the receipt of an authorization to put the work in process.

The Order of Work.—When the routing officer has finished his preparation, the manufacturing order so covered is ready, at a moment's notice, to be slipped into its place in the program of shop operations. The production manager or clerk, with his aids in the planning room and the shop, has the function of adjusting the requirements of sales and stock to the requirement that all machines and work places shall be steadily occupied He must be kept informed as to sales, and quantities in stock;

and equally so as to changes in the productive power of the shops, due to breakdowns, repairs, absence of workmen, etc. This officer arranges for his guidance a balance of work account, which shows the amount of work ahead for each machine or work place, making additions as new work is ordered, and subtractions as work is completed. With this as his general guide, he arranges a work schedule in which orders are adjusted into the best possible sequence. He guides his assistants in the details of scheduling, and checks accomplishments frequently. His program must be modified when the productive power of the shops is reduced, when defective work must be re-manufactured, and when emergency orders must be given right of way. Through clerks in the shop offices, he operates departmental bulletin boards, upon which waiting orders are distributed by machine and work place, he issues to the foremen the time cards, move orders, inspection orders, drawings, instruction cards, tool lists, etc , for the next jobs, and he receives the same documents back for work which has been finished.

The routing and order-of-work forms of control, which became a part of the practice of scientific management, were based upon the systems first developed by Oberlin Smith, of the Ferracute Machine Company of Bridgeton, N. J., and by William H. Thorne, of William Sellers and Company of Philadelphia It is only by such careful planning in advance that the right materials, tools, equipment, and instructions can be brought regularly to the right workman at the right time, so that the investment involved in standardization, and the work of the various service departments, can be profitably utilized through the steady achievement of a high standard of output.

The Stock Department.—Scientific management calls for the organization of a stock department much as it now exists in well-managed businesses. It, however, advocates a special form of control to be exercised by a clerk in the planning room. This functionary presides over a balance of stores ledger which shows at all times quantities on hand, quantities on order but not received, quantities apportioned to present orders but not issued, and quantities available for future orders The stock department is under the control of this account, its own functions being reduced to receiving, storage, and issuing, with an account

showing balance on hand Further consideration of the work of a stock department will be postponed to the chapter on Purchasing and Stores.

The Tool Department.—Frederick W Taylor was, from his first advent into industry, well acquainted with the methods used in the William Sellers and Company plant in Philadelphia. This establishment, as early as 1876, had investigated the shapes of tools for metal cutting. By 1878 it had a finely designed tool grinding machine, had well organized its tool room, and had developed the function of issuing tools properly conditioned to the workmen. This example stimulated Taylor to the extensive investigation of metal-cutting tools an investigation which revealed first, the advantage of directing a stream of water upon the point of the tool, next, showed the secondary part played by slight changes in the angles of tools, then indicated which of the tool steels was best for any particular use and, finally, led to the sensational discovery of high-speed steel, which has revolutionized machine shop practice throughout the world.

In 1898, Taylor described the tool situation in the average shop in the following words "If, in the ordinary machine shop, a foreman were to order any one of his men to do a certain job on piece work and attempt to tell the man what cutting speed and feed to use the result would be in nine cases out of ten that the man would grind his tools so that they could not do the work. If the foreman were then to put another man onto the machine he would probably find that the first man had either hidden many of his best tools belonging to the lathe or transferred them to some friend in the shop, so that the new man coming onto the machine would have to spend perhaps two or three days in getting tools dressed and ground before he could start to do the work, and even then unless he were skilled in the art of designing machine shop tools, which not one machinist in a thousand is, he would probably have tools made that would fail to do the work economically on this particular machine.

"It is just such obstacles as this that prevent the introduction of piece work in most shops. The first step therefore toward introducing piece work lies in a careful study of all the trifling

details of the shop and a thorough systematizing of this part of the establishment "[1]

In place of this confusion and inefficiency, scientific management requires a central tool room containing an ample supply of each type of tool required in the plant, each tool to be carefully chosen as the best for its particular purpose, all tools to be marked with mnemonic symbols, and conveniently stored according to a system of classification All tools required for a particular job are to be assembled at the work place by a foreman, before the workman has completed the preceding job After the completion of the job, the tools are returned to the tool room, being issued and accounted for by requisitions. Used tools are not placed in storage until they have been inspected, and if necessary re-forged and re-ground

The immediate material agency in manufacturing is the point of the tool The problems of labor and management largely concentrate upon the task of bringing a succession of small cutting, grinding, or hammering surfaces into contact with materials, under given conditions as to stress, angle, temperature, and the like. A bench worker depends for the amount and quality of his day's work upon the sharpness of a few inches of cutting edge on his chisels A ditch digger may waste 10 per cent of his energy by forcing an extra eighth of an inch of pick point into the clay. So important to any establishment is the condition of a few pounds of steel on the points of the tools that efficiency demands that the design of tools, the matter of an adequate supply, the sharpening and repairing of them, and their accessibility, should be taken out of the hands of workmen and general foremen and concentrated in the hands of specialists who can apply system and science to the tasks.

Nomenclature.—One cause of delay and misunderstanding, in the ordinary establishment, is that general descriptive terms are used to designate tools, machine parts, work places, raw stores, finished stock, supplies, subdivisions of accounts, etc. As different people use names and qualifying adjectives differently, it results that wrong entries are made in the books, the wrong tools are brought, the wrong part is manufactured, or the wrong

[1] Frederick W Taylor, Frank B Copley, N Y Harper and Brothers, 1923, Vol II, pp 11–12

product is shipped It is necessary, therefore, either to adopt a highly artificial set of definitions for words, or else avoid words, because they drag in alien significations, and choose symbols such as letters or numbers which have no confusing signification in themselves and therefore can suggest but one thing, namely, the meaning assigned to them. But if one were to proceed through lists of things and attach letters or numbers to them in rotation it would be necessary to carry a pocket lexicon, find the definition of the thing, and copy out the symbol.

It is necessary to make the symbols mnemonic, or capable of being remembered. To do this the identifying signs must refer to the parts of a system of logical classification, which begins with the most general class, and proceeds step by step to subdivide (passing at each step from the general toward the specific), until each thing at last falls into a final class within which the items are interchangeable. When such a classification has been made, the symbols are attached. In doing this attention must first be given to the first step of analysis only, each item in this classification receiving a symbol assigned from an homologous series such as the alphabet or the first nine digits. Next, attention is given to the second stage of classification, the items as before receiving letters or numbers. In this fashion the attaching of symbols proceeds to the end of the classification. It is an aid to memory if the letters used are, as far as possible, the initial letters of names used in the classification.

The complete symbol of anything can now be picked out by beginning with the most general classification and taking the symbol of the class in which the desired article belongs, and passing down through the classification, picking up and adding on the symbols of the classes and subclasses which are in the direct line to the final class of the article. To illustrate, the symbol for a part of a moulding machine might be WMRBS3, derived as follows.

W = Worked material
M = Worked material used for moulding machines only.
R = Rammer type of moulding machine
B = Base group in the rammer moulding machine.
S = Strain bar division of the base group
3 = Third piece in the strain bar division.

The symbol of a $\frac{1}{2}$ pound unbleached sponge might be SVATSU2, compounded of.

S = Stores.
V = Stores used for a variety of purposes
A = Miscellaneous class of stores used for a variety of purposes.
T = Textile fibrous materials not elsewhere classified.
S = Sponges
U = Unbleached.
2 = Number to the pound.

Such a system as this has the merit of absolute identification, of carrying no confusing alternate significance, and of having an open end at each step in the classification for the addition of new categories as desired It looks forbidding at first, but it soon becomes familiar and easy to use. When once familiar, it is infinitely to be preferred to the perpetual process of describing and correcting which is incident to the use of ordinary descriptive terms.

Time Study

It is not until the standardization of the shop, and of all the service agencies which work for it, has been completed that the attempt should be made to determine the proper speed of human operations. The environment must be dependable if it is expected that the worker's progress with his task is to be dependable In 1881 Frederick W. Taylor began, at the Midvale Steel Company plant, a minute and intensive study of the movements of workmen in production, in the endeavor to find a way out of the continuous struggle which was going on between management and men as to what constituted a fair day's work. With this struggle Taylor had been made painfully familiar, through experience both as an apprentice and journeyman and as a shop foreman. In 1883 E. H. Miller was employed to devote his entire time to this investigation. In this way was begun an entirely new form of application of the scientific method to industry.

The nature of time study as a procedure is to analyze the complex chain of movements used in production into its elements, or into simple groups of elements, to criticize these elementary

movements with reference to their speed and appropriateness (or economy of effort), to build up synthetically a new chain of movements out of the most rapid and economical elements found, to add an allowance, studied with equal care, to cover the requirements of the laborer as a physical organism and as a normal human being working in an environment not strictly dependable, with something extra as a factor of safety; and, finally, to prescribe the standard thus arrived at as the ideal to be attained in practice, after a reasonable learning period has been passed through.

By means of time studies, scientific management aims to continue and complete the work begun in the taking of the time of machine operations When to the times allotted for the machine elements of work, it is possible to add the times which manual operations will consume, the total composes the standard time for the job. These times can be entered upon the worker's instruction card along with machine times, can be enforced by the foremen in the shops along with machine times, and can complete all time calculations involved in routing and order-of-work control.

The officer in charge of time studies may be called the time study and instruction card clerk. He cooperates with the routing clerk in the preparation of instruction cards. Upon these he enters brief descriptions of the operations. He prescribes on them the methods to be followed, and the tools and equipments to be provided. He sets down, for the worker's information, the elementary times (both machine times and handling times), the allowance time, and the total time, which is the standard time prescribed for the job, and which is an influential factor in determining the rate of pay.

Not Total Elapsed Time.—Time study begins with the measurement of the times required for elementary human movements, or simple groups of movements It does not concern itself, at first, with the total elapsed time of jobs. Although the ultimate object is a figure representing the proper total time for a task, the method of getting it is not to record the beginning and ending times of a series of acts, as a judge at a race-track would do, or a timekeeper at an athletic contest If we measure a series *en bloc* we get a time which cannot be compared

with that of any other series unless that series is composed of identical units. If there are differences between two series, and we attempt to allow for them, we find ourselves at once considering component elements, and trying to calculate the effect of the presence or absence of certain elements But we can only successfully allow for differences in elements after having studied the times of elements.

Tasks are infinite in variety, but the elementary movements of which they are composed are comparatively few in number. If we attempt the direct measurement of complete tasks our judgment will be lost in infinite variety, but if we observe the times of the elements, the small number of typical movements makes it possible to attain sound judgment It is because workmen measure only total elapsed time that, even though they may have been engaged for a lifetime upon a certain class of work, they rarely arrive at an intelligent knowledge of how long a task should take under altered conditions. The time-study expert, on the other hand, can quickly analyze work which is unfamiliar to him, just as a chemist can analyze a substance which he has never seen before.

Motion Study.—In the early period of the application of time-study to any task there is a valuable product accompanying the taking of times which arises from the perception, by the time-study expert, of varying degrees of appropriateness in the motions observed and of convenience in the equipment employed. This scrutiny of motions has been called " motion study." It has been defined by its leading protagonist, Frank B. Gilbreth, as follows: " Motion study is the science of eliminating wastefulness resulting from using unnecessary, ill-directed, and inefficient motions. The aim of motion study is to find and perpetuate the scheme of least waste methods of labor "[1]

Time and motion study are fertile in suggestions of possible improvements in working conditions Into the mind of the student there come ideas for improved layout, height or design or location of containers, height of working table, seats, design of tools, machine design, location of machine levers, location of loose tools, location of lights, methods of working, quantities

[1] Primer of Scientific Management, Frank B. Gilbreth, N Y Van Nostrand, 1914 p 8

to be handled in one motion, accident-preventing appliances, etc., etc.

Motion study aims to eliminate useless motions and save time and energy. It strives to link motions to each other in the most economical sequences, so that the end of one movement is as nearly as may be the starting point for the next. It endeavors to substitute a few effective movements for a multiplicity of ineffectual ones, as when a mason is instructed to lift a packet of twenty-four brick to the wall, instead of laboriously transferring each brick separately. In the measure that motion study succeeds in achieving its aim it discovers the best method, and prepares the way for a standardization of processes and equipment such as will permit permanent time studies to be taken.

Composition of the Standard Time.—A sufficient series of measurements of each elementary operation must be taken to make possible a sound opinion as to what the best time is On this point, Mr. Dwight V. Merrick, who is an experienced time-study expert, says, "If the elementary operations require a reasonably long time and the work is being done at a uniform rate, a few complete observations will suffice. On the other hand, if the elementary operations are very short and from any cause successive pieces are not produced at a uniform rate, a great many observations may be required." [1]

An observation sheet is reproduced (Fig. 30), containing several measurements of each of a series of elementary movements, showing in the right-hand column the time chosen to represent each element, summing these up as the total minimum time for the task, adding allowance and, finally, as the sum of the latter two, indicating the standard prescribed for the task. It will be observed that the method is to select the minimum time and build up from it to the standard by means of allowances.

It may be asked why the lowest record is taken rather than some other record. For any series of measurements there are several figures, any one of which may be chosen to represent the series. We can take the median time, or the time which will divide the series into two parts, a higher and a lower, each

[1] Making Instruction Cards from Time Studies, Dwight V. Merrick Iron Age, March 11, 1915, p. 561.

OBSERVATION SHEET

Observer's name *Workman's name* *Piece* .

	Detail of Observation	Individual Times (In minutes and hundredths) 1	2	3	4	5	Minimum Times
1	Put board in place.	04	03	05	05	06	03
2	Place pattern on board.. .. .	03	05	03	04	05	03
3	Place drag in position.	10	08	11	14	12	08
4	Sprinkle parting on pattern.	04	07	04	03	05	03
5	Shovel on facing sand... ..	06	02	03	04	03	02
6	Ram. . .	20	14	22	21	19	14
7	Fill drag with backing sand..	07	13	05	07	08	05
8	Ram. . .	29	26	24	24	17	17
9	Strike off . .	13	15	15	08	08	08
10	Place bottom board... . ..	08	07	09	09	13	07
11	Roll drag over	09	12	11	12	16	09
12	Remove board . .	03	02	03	03	04	02
13	Sprinkle parting on pattern.	09	06	03	08	09	03
14	Place cope in position .	08	08	09	12	13	08
15	Place gates	08	.10	13	11	09	08
16	Shovel in facing sand	07	08	02	09	10	02
17	Ram. .	18	.17	.18	18	19	14
18	Fill cope with backing sand...	12	12	.14	13	10	10
19	Ram.	30	.25	.25	20	25	20
20	Strike off..	12	.18	20	20	17	12
21	Draw gate...	10	.10	15	16	11	10
22	Remove cope...	15	.15	06	09	10	06
23	Draw pattern . .	60	58	63	62	65	58
24	Patch mould..	30	29	.29	30	28	28
25	Open gate.	.20	20	20	21	23	20
26	Close mould .	12	.15	12	11	12	11
27	Remove to floor remove flask	18	.25	29	28	30	18

Total minimum time.. . .	3 09
Allowance (60 per cent).	1 85
Time it should take to set one mould	4 94
To earn premium, work must be done in time and $\frac{2}{3}$ or	8 23

FIG 30 —SAMPLE OF A TIME STUDY SHEET

containing an equal number of observations. And we might justify ourselves in this on the ground that each individual case makes its contribution toward the discovery of the proper time. Or we can take the mode of the series, that is to say, the record which appears most frequently; and do so on the theory that the record found most often represents the normal equilibrium into which the usual, permanent, and legitimate factors of the case tend to fall. There is another argument for using the mode or the most frequently represented time, and that is that the times of first-class performances tend to be similar. This is so because they represent the necessary times for appropriate acts only, and are free from the incalculable additions which represent unnecessary motions, hesitations, mistakes, and accidents. Still another possible choice is the average time, or the time which will be given if the sum of times of the series be divided by the number of the observations. Such a figure is more complex than the others as it gives weight to the number of instances, and also to the quantitative variation.

The reason why these times are not taken,[1] is that they represent in various slightly different fashions—except the mode where it is certain that mode times represent first-class men—the commonplace or mediocre reaction of the workman of average ability to his environment and task. As such, they offer no basis for any other than the average or customary wage of the craft in the locality at the time. If a management, after having prepared a specially efficient working environment at much expense, desires to man its work places with specially efficient men, the standard times set for tasks must be something better than the average performance of the average man. If such a management wishes to offer wages above the average for a performance which is above the average, it cannot accept the median, the accidental mode, or the average record as its standard.

By the use of minimum times, the influence of deliberate attempts at soldiering is largely, if not wholly, eliminated, for

[1] There are, of course, an innumerable number of compromise positions, below the strict standard of first-class time, which may be taken, in view of what is feasible under given conditions Mr C E Knoeppel recommends a time approximately midway between the best recorded time and average time.

the time records made by soldiering workmen are high and hence are disregarded by the method which builds up the standard time on the basis of the best performance records The minimum time, which is usually chosen by efficiency experts, represents a capable man working under the best conditions, a state of things proper to hold up as the ideal. By taking the lowest records a great advantage in method is attained, namely, that one question is taken up for decision at a time. The lowest time is assumed to be pure, net performance; as simple and homogeneous a thing as is available, and a measurement as free as possible from indefinite elements representing rest, incompetency, unavoidable interruptions, etc. If we begin with such a time, we can then, in proper turn, consider the making of allowance for all the retarding causes which prevent the attainment of the minimum.

Allowance.—Allowance is added to the minimum task time to produce the standard or proper task time In the allowance it is intended to take care of rest periods, and the personal requirements of the employee, variations in the quality of materials or in the condition of equipment, the lower performance of the later hours of the day, and the fact that all the men who will be retained as satisfactory for a job are not equal to the best man. In short, allowance is intended to cover all immeasurable and unstandardizable elements of performance which influence the time. It is a lump sum to cover all time-influencing factors which it is not yet possible to submit to scientific measurement It is, therefore, the most difficult item to determine in the whole process of time setting.

The amount of the allowance should differ with the nature of the work, with the rest intervals necessary, and with the degree of control attained over power, equipment, tools, etc. At the Tabor Manufacturing Company in Philadelphia, the allowance on handling time varies from 30 to 80 per cent. Mr. Taylor, who aimed at high performance, and desired only the best men, and who determined task times with great care, found an allowance of from 20 to 27 per cent satisfactory.

Practical Application.—The making of a time study and the setting of a standard time involves considerable expense This expense need not be repeated if the job is repeated under like conditions. Therefore, the expense is in the nature of a fixed

charge upon the job. In plants where work is constantly changing and jobs are small, this expense may be prohibitive In any establishment using time studies there will be a fringe of small unstandardized tasks, such as repair work, emergency jobs, the experimental manufacture incident to designing, etc., which will not be brought under the standard time system.

It can be said that the method is not one of hair-line accuracy Its conclusions cover the operation of many unmeasured variables. Nevertheless, experience has proved that it is penetrating in its illumination of the dark subject of what a first-class man should do in a day. It possesses a power of prediction sufficient to entitle it to be considered a practical, reasonably accurate scientific method. The option at present is either to use it or to rest upon the chaos of rumor and tradition which current opinion as to a fair day's work represents, for no other superior method has yet been suggested.

Problems

Rules for the Guidance of Rate Setters.—The questions and answers of the first examination of a rate setter's class in an Atlantic Coast shipyard were as follows:

"*Q* Of what use is time study?

A. To find out exactly what is being done, and having for its ultimate purpose increased accomplishment with the means available, to determine the time spent in non-productive effort and the standard time to be allowed per unit of production upon which planning and paying can be based.

Q. What is the first step in the actual taking of a time study?

A To analyze a job into its component parts or elements

Q To what extent should a job be split into elements when making a time study, and by what factors should the observer be governed as to the minuteness of the elements?

A A job should be split into a sufficient number of elements to allow the observer to be able to distinguish between productive and non-productive operations The observer should be governed by the frequency of the recurrence of the elements in the work studied and its relation to the work of a similar nature

Q Upon what class of worker should the standard be set (as to ability)?

A. A first-class worker, but not the exceptional man, for the special job in the class of work to be timed.

Q What determines the allowance that should be made for rest?

A The amount of rest allowance varies in proportion to the length and nature of the job, together with the physical and mental energy expended, together with the nervous strain in special cases it is also affected by conditions and surroundings

Q Should observations be taken with or without the knowledge of the workman, and why?

A With the knowledge of the worker, because studies taken without the knowledge would be unjust and would create distrust and ill feeling"

With this as a beginning, prepare a code of rules to govern the rate setters and time study men of a manufacturing plant Consult the references on time study in the chapter bibliography.

Time Study Principles and Safeguards.—What answers, or statements of proper procedure, can you prepare in response to the criticisms of time study involved in the following questions

"How can any one think it fair to take stop-watch records on the best men available, and then expect the rank and file to keep up with such records?" "Does not the speed-boss speed up the men to an extent which is injurious?" "Is there any adequate safeguard to prevent the pace, which is set as the standard, from being one which wears out the men in a short time, or in the course of a few years?"

References—Taylor, F. W, Principles of Scientific Management, pp 56–62, Hoxie, R F, Scientific Management and Labor, pp 87–92, Gilbreth, F B, Primer of Scientific Management, pp 56 and 65, and references in the bibliography of this chapter

Motion Study Filling Envelopes.—The following problem has been used by the Dennison Manufacturing Company in its Management Class for foremen "A table worker is putting up small cards in envelopes. The envelopes come to her in boxes of 500's with gummed flaps, folded over The goods are printed cards which have to be faced with the printing all one way in the envelopes The cards are supplied loose in large cases, each case weighing about 100 lbs The cards come all inspected, and no further inspection is necessary One dozen cards are put up in each envelope, and the flap of the envelope has to be sealed down securely The filled envelopes are to be placed in cartons of 25 envelopes each These cartons come in paper packages with about 100 cartons to a package The size of the package is about 2 ft by 2 ft by 2 ft The work bench on which the work is being done is 5 ft. long, 30 ins high from the floor to the top of the bench, and 30 ins wide.

"Would you change any of the above conditions, and if so state what you would change, and why? Show by diagram how you would arrange the different materials and implements in relation to the worker. Also, make a list of the implements and materials to be used."

Motion Study: Typewriting.—Demonstrate right and wrong methods in the layout and equipment of a work place for typewriting For this series of tests it is desirable to provide

A table adjustable as to height,
A chair adjustable as to height,
Material for foot rest,
A typewriter,
Supplies such as are used by a typewriter,
Means of regulating lighting,
Various special improved equipments for rendering more easy the work of typewriting (these in certain cases to be held in reserve by the instructor until called for).

The motion study demonstration may be given in either of two ways first, a thoroughly bad equipment and layout being developed, with as many obvious and hidden faults as possible, and improvements introduced one by one as called for by the class, or, second, a good equipment and layout demonstrated with the challenge to the class to find flaws

Motion Study: Folding Letters.—Demonstrate right or wrong methods in the equipment and layout, and in the methods of working, posture, manual movements, speed, etc., in a process of folding 100 sheets of paper, each $8\frac{1}{2}$ ins. by 11 ins in size, inserting them in 100 envelopes approximately $3\frac{5}{8}$ ins by $6\frac{3}{4}$ ins. in size, and sealing the envelopes. The equipment desirable is

A table adjustable as to height,
A chair adjustable as to height,
Equipment for moistening the flaps of the envelopes,
A variety of containers for holding stock before and after it is worked upon

This study may be made in two ways either demonstrating an inefficient layout, equipment, and method (or some one inefficient element) with a call for criticisms, or demonstrating a carefully perfected method with a challenge to find flaws

Note on Motion Studies.—If the equipment suggested in Chapter IV on Layout, for a peg board test has been provided, it may be used in connection with motion studies of the operative's position, posture, manual movement, sequence of movements, pauses, etc , etc If the equipment for making time studies has been provided, time studies can be coupled with motion studies

A Faulty Shop System.—A writer on scientific management has given the following illustration of methods which are still common· "I know of a plant in Philadelphia manufacturing textile machinery, that for years never had a drawing or even a sketch of its product. When they

started in business they had a number of patterns made, and thereafter when a new machine was ordered, the foreman looked over these patterns, which were hung upon the walls of the plant as ornaments picked out those most like what he wanted, explained to the pattern-maker what he wanted taken off here, added on there, rounded here, squared up there, and in the light of this order, the pattern-maker went to work When the castings were finally obtained, they were tried together and machined into some kind of fit, and where this was impossible, new castings were made

"One Saturday this company got a big order for machines of a certain type, which it had made three years before The delivery date was pretty short, so the superintendent called a meeting of his foremen on Sunday morning After an all-day session, they had listed the parts necessary for the machine. When the parts were finally assembled, they found that they had omitted over three hundred This was thoroughly typical of the entire administration of this plant" Indicate in a series of points or steps what an efficiency engineer would do in this establishment

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CHAPTER XII

SCIENTIFIC MANAGEMENT—Continued

Personnel

Any establishment which develops a type of control similar to scientific management will have a considerable number of its functions very much enlarged. The attempt to keep equipment and tools up to a high mark of efficiency, to plan all operations ahead, to serve workmen promptly with everything required for the job, to work at a fast pace and maintain quality, and to manipulate the authorization and report forms required, will demand considerable additions to staff.

The characteristic situation which the pioneers of scientific management encountered was a general superintendent's or works manager's office, undermanned, and with inadequate ideas as to control, supplemented by a few half-functioning service departments concerned with accounts, purchasing, stock, design, and repairs. Far away, administratively, from these were the foremen, each in his own shop struggling with the full round of responsibilities, much as the proprietor of a small one-man plant might do. From the shoulders of the general management responsibilities dropped—a long distance—upon the foreman. From the foremen they fell upon the workmen. In the hands of the workmen they were about half met

The foreman is commonly the sole administrative agency of the shop. He is expected to look after tools and machines, find materials and supplies for his men, instruct them in the manner of doing work, arrange tasks so that every one is kept busy, enforce a proper pace, write up the job cards and other records, preserve order, make reports as requested concerning the progress of individual jobs, inspect work for quality, lend a hand in repairs, suggest improvements in equipment, and give an opinion on which to base promotions and discharges. This is a tremendous

range of functions so that, although the foreman is about the finest type of all-round man to be found in industry, he cannot achieve more than an indifferent result as to efficiency He may be informally aided by "leading hands" somewhat as a corporal serves his sergeant, but most matters must be left to custom and the inclination of the men Hence the general demand for "experienced" workmen, a demand which means that men are wanted who can take care of themselves and not bother the foreman In the one-foreman shop, practice remains at a low level, while yet there is demanded excess capacity in the men, above what is needed for craft work alone, to enable them to perform administrative functions. When responsibilities of a discretionary character, concerning processes and equipment, are thrust upon craftsmen in this shiftless way, they rest upon persons not trained for them, not adequately clothed with authority, without effective leisure from manual operations, and without the stimulus of a prospect of an administrative career.

In the old-fashioned shop, all information and assistance which the higher executives, the general departments, the general manager, and the service departments can render to the workmen must pass through one channel—the single foreman. If there are twenty executives above the foreman, and twenty operatives under him, one mind is called upon to serve as the intellectual connection for four hundred possible personal relationships between superior and subordinate It is obvious that we have here an administrative blockade. Here is a weak link in the chain of authority connecting higher with lower. Scientific management has put its finger upon this weak spot.

The Planning Room.—The central agency developed to take care of the new duties is called a planning room. To it functions are carried down from the general superintendent's office, and other functions are carried up from the foremen and the workmen This office aims to do for shop processes what the drafting room or engineering department does for design Some one has said: "The drafting department is the planning room of design· the planning room is the drafting department of production." In the planning room the functions of routing, order of work, preparation of instruction cards, compilation of time study records, compilation of machine speed records, maintenance

of balance of stores records, and maintenance of cost account records may be centered. Separate departments will deal with design, tools, stores, purchasing, proprietorship accounts, and employment management.

As Taylor said, after describing the functions of his planning

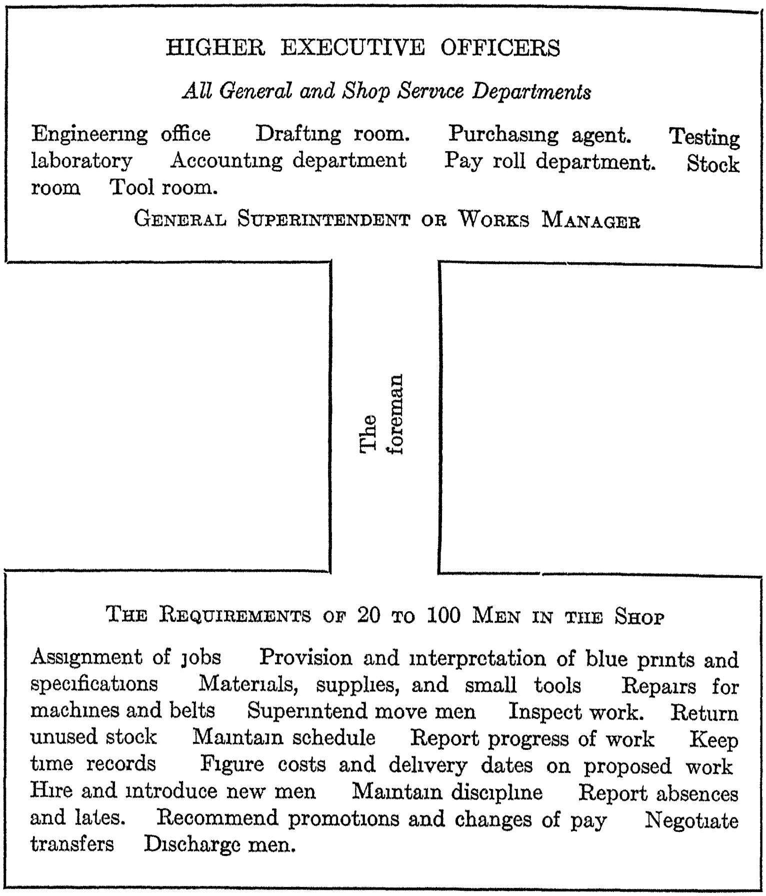

FIG. 31.—THE TRADITIONAL SYSTEM OF FOREMANIZING.

department, "At first view the running of a planning department, together with the other innovations, would appear to involve a large amount of additional work and expense, and the most natural question is whether the increased efficiency of the shop

more than offsets this outlay. It must be borne in mind, however, that, with the exception of the study of unit times, there is hardly a single item of work done in the planning department

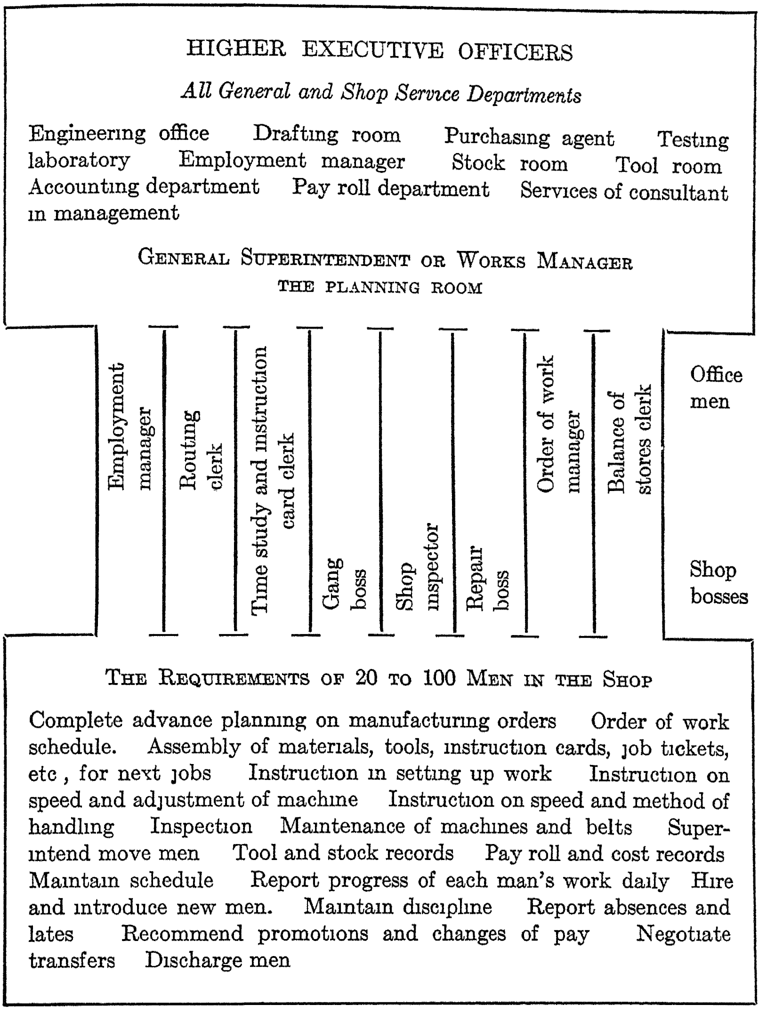

FIG 32.—THE FUNCTIONAL SYSTEM OF FOREMANIZING

which is not already being done in the shop. Establishing a planning department merely concentrates the planning and much

other brainwork in a few men especially fitted for their task and trained in their especial lines, instead of having it done, as heretofore, in most cases by high-priced mechanics, well fitted to work at their trades, but poorly trained for work more or less clerical in its nature."[1]

No standard personnel can be recommended for all cases. The essential things underlying personnel are the range of functions and the mass of work. Scientific management suggests a characteristic range of functions. The mass of work will depend upon the size of the plant and the type of manufacturing carried on.

Functional Foremen.—The effect of the introduction of scientific management upon the foreman of the shop is to relieve him of a portion of his responsibilities, which portion is transferred to the staff of the planning room. But upon him many functions previously performed indifferently by workmen are placed, and new functions are added. The net result is to call for more foremanizing activity than before. It is necessary, therefore, to supplement the foreman, and this development of new personnel in the shop naturally takes place along functional lines.

In a general way, the functions of shop control tend to classify themselves as assembling the facilities for the job, supervising the actual operations of men and machines for output, maintaining quality, maintaining equipment in repair, and preserving discipline. Along similar lines the functionalization of personnel proceeds as development requires. As a general rule the sovereignty of one boss in the shop is not so seriously curtailed as to be entirely disrupted.

Frederick W. Taylor frequently recommended a plan of functionalization involving

For the planning room
1 An order of work and route clerk.
2. An instruction card clerk.
3 A time and cost clerk
4. A shop disciplinarian in charge of employee record (a sort of employment manager in embryo)

For the shop
1. A gang boss, to assemble the requisites for jobs, instruct in setting up work, and have general charge of the shop

[1] Shop Management, Frederick W Taylor, N Y., 1911. Harper.

2. A machine speed boss
3 An inspector, concerned with quality of product.
4 A repair boss

Neither this particular division of labor, nor any other set scheme can be said to characterize any large number of scientific management installations The development of specialties in the general field of foremanizing commends itself, however, on the ground of economy in the use of talent. As Taylor said, after listing nine duties devolving upon the ordinary gang boss, "If such a man could be found he should be made manager or superintendent of a works instead of gang boss"[1]

With division of functions the partial man can be utilized. The psychology of foreman specialization has been explained, by W E Freeland, on the basis of the experience of the Winchester Repeating Arms Company, as follows "For planning, a man must have analytical power, the ability to dissect a task and break it down into its elements, he must have imagination to put these elements together into a complete whole, he must have reasoning power to formulate and plan the accomplishment of the work The man in charge of preparation must be ingenious, resourceful, inventive. If he is on mechanical work he must have the mechanical instinct. The schedule man must have a sense of time and sequence and of relative importance He must have the ability to recognize the relative importance of things in time and cost and to arrange them in the order of their importance or their magnitude and, if the order of importance conflicts with the order of magnitude, to determine which of the two shall govern The work requires an orderly, systematic, clerical mind. The production man must be forceful, aggressive, driving, tenacious, persistent—the truly executive type. He must be able to control men, to guide them, push them, pull them. Inspection of work requires the precise, particular, patient, judicious type. . . . It is more important to get the right type of man than it is to determine whether he has the highest degree of knowledge for the particular thing he is to do. A man may know very little of the particular set of activities he is to super-

[1] Shop Management, Frederick W Taylor, N Y, 1911 Harper

vise if he has the right set of characteristics and the right temperament for the job to which he is assigned."[1]

Orders and Reports.—A great step was taken, years ago, in engineering establishments, when drafting rooms began to send down blue prints to the shops, as a means of controlling the dimensions of work. Scientific management aims to extend this idea and establish administrative control of the times, methods, and equipments used in the shop, by means of orders issued from the planning room.

A complete instruction card in a well-managed establishment is quite an elaborate affair. In an engineering establishment it includes, among other things, necessary drawings, descriptions of the work to be done and the methods to be used, lists of materials, tools, attachments, jigs, and gauges, the sequence of operations, the list of elementary minimum times, the standard or prescribed time, and the wage rate. A sample instruction card, such as is used in connection with scientific management, is presented in Fig. 33. In such instructions as this, it is possible to put before the worker in condensed and practical form information which it has taken years of work to procure. In such preparation there is no useless work done, however, for there is no point decided which will not inevitably arise for decision during the progress of production. To use standard orders means simply to appoint capable men to decide matters once for all, in advance, and under favorable conditions, rather than allow these matters to drift until they are encountered in the progress of work, so that production stops while the workman ponders and experiments, or rummages for lost tools, or travels to the stock room, or hunts his boss.

The prompt and detailed control required in scientific management necessitates the use of a considerable variety of authorization forms and report forms. These are for the most part very brief. They are quickly used; and they flow back into the offices so rapidly that they are available for any tabulations that may be desired to show progress of work or costs. Mr. Taylor found one particular report especially useful. He said, in 1911: "We have found for economy that the record which

[1] The Winchester Plan of Management, W. E Freeland Iron Age, Jan 3, 1918, p 129.

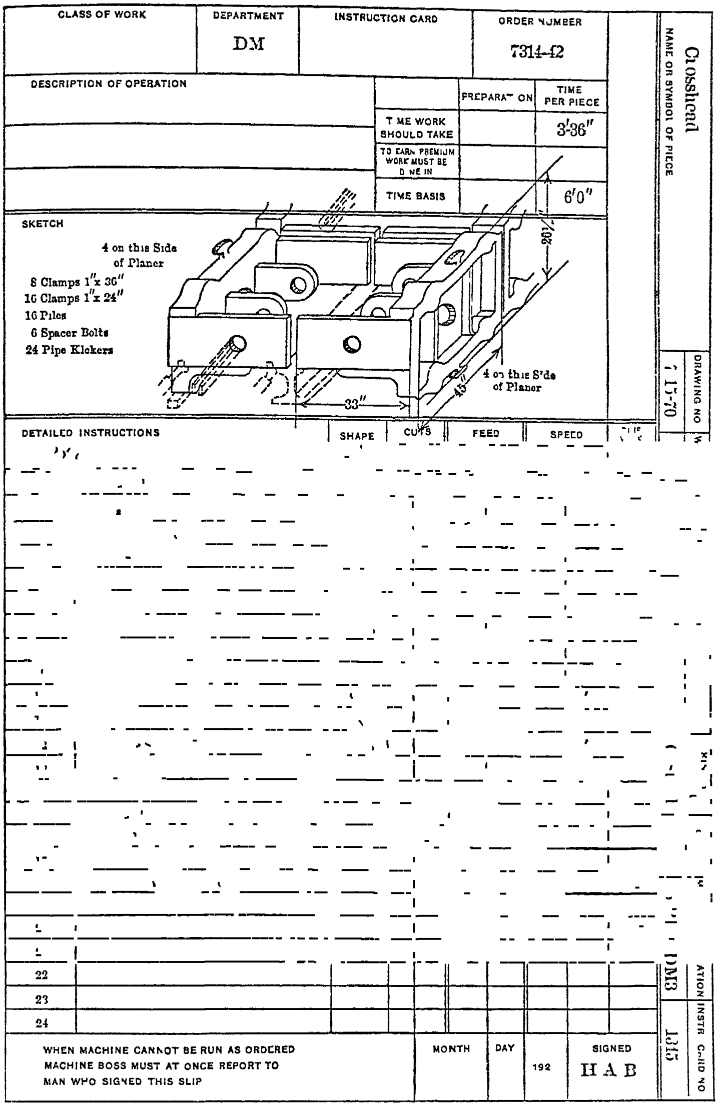

FIG. 33—INSTRUCTION CARD UNDER SCIENTIFIC MANAGEMENT.

is made up early on the morning of the day following the work, which shows how many men in each department failed to earn their bonus, is the most helpful record in promoting economy It becomes possible then, the day after bad work has been done by anybody, to chase it right home, either to the foreman, the teachers, the tool department, planning department, or the workman himself, and prove right then and there to the men or the department just what they have done that is wrong."[1]

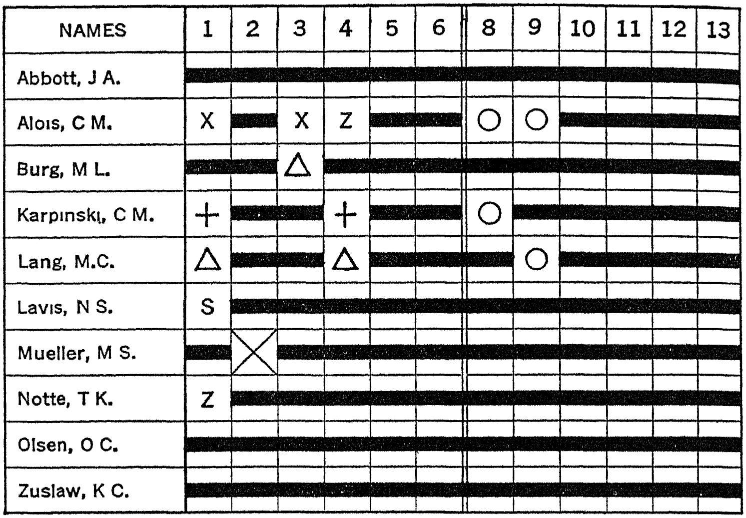

FIG 34.—LINE CHART TO SHOW DAILY BONUS EARNED

Symbols may be used to indicate *absent, failure to make bonus, spoiled work, part of a day, repairs needed, tools needed, defective material, lack of instruction, new operator, reason not clear*, etc.

A simple line tabulation is given in Fig. 34, which may be adapted to a variety of uses. In the case illustrated normal functioning is indicated when the lines are continuous. The breaks, which readily catch the eye, may contain any desired symbols explaining the causes of failure Charts of this order, but constructed to permit the statement of percentages, were

[1] Frederick W Taylor, Frank B Copley, N Y. Harper, 1923, Vol I, p. 368.

much used by H L. Gantt, and are explained in his Organizing for Work.[1]

Wages and Scientific Management.—The wage problem is to be taken up in a series of later chapters It must suffice here to indicate briefly some things actually done under scientific management, either in public work or in plants where Taylor's influence was dominant.

At the Midvale Steel plant in Philadelphia, in the case of a steel forging turned in a lathe, production was raised from 5 to 10 per day. The price rate was cut from 50 cents to 35 cents per piece for 10 pieces per day, or 25 cents per piece for less than 10 pieces per day. The daily earnings of the worker increased from $2 50 to $3.50 per day. Costs dropped from $1.17 to 69 cents each.[2]

At the Bethlehem Steel plant, the handling of material in the yards required 400 to 600 men. With the new methods 140 men were able to do equal work. The old wages were $1 15 a day; the new $1.85. Calculating 300 working days in the year for 140 men, at an advance of 70 cents per day, the total wage increase appears to be approximately $29,400 for the men retained. The company's profit in the improvement, after deducting all overhead and extra operating expense, was $78,000.[3]

At the Mare Island Navy Yard, wood calkers were doing 80 to 100 ft. With the new system 380 to 400 ft. per day were done. The former wages were $4.50 to $5.00; the new wages were $7 50 to $8 00. In the same yard unskilled laborers were removing 50 to 60 sq ft of rust and barnacles with pneumatic hammers. The new performance became 180 to 210 sq. ft. The old wages were $2.40 a day, the new were $3.30 to $3.80 a day.[4]

At the Watertown Arsenal, the molds for pack saddle pommels were made in the foundry under the old system at the rate of 9 per day. The new rate became 24 molds per day. The old

[1] Organizing for Work, H L Gantt, N Y Harcourt, 1919 See also The Gantt Chart, Wallace Clark, N Y, 1922 The Ronald Press

[2] Frederick W. Taylor, Frank B. Copley, N. Y. Harper & Brothers, 1923, Vol I, p 317.

[3] Ibid, Vol II, pp 66–67.

[4] Ibid, Vol II, p 308.

wages were \$3 28 a day; the new were \$5 74 per day. The total cost of the molds to the government fell from \$1 17 to 54 cents [1]

Before one concludes from these instances that wages were not sufficiently raised in comparison with savings made or the increase in profits, three things should be considered. The first is that the increase of output does not indicate a corresponding increase in effort put forth by the worker. To argue this would be to argue that previously he had been a frightful slacker. The tools and methods and the work environment generally were greatly improved. There was increase of effort, doubtless, but not anything approaching the increase in output. The second point is that scientific management is not a profit sharing system It simply endeavors to find the rate of wages which will be satisfactory to the worker, and will secure from him adequate cooperation in production. In the third place, these profits under scientific management generally, such as they are, have not been high enough to induce a very rapid introduction of the system. Scientific management is difficult and expensive. So long as there are easier ways of making profits they will be followed. The recent history of American manufacture makes it appear that there are easier ways such as consolidation, production on a large scale, the reduction of manufacturing to repetitive-process types of operation, artificial monopoly from legal protection to patents, trade marks, and trade names, and artificial monopoly through tariff laws The refined scientific method will go slowly until there is greater economic pressure.

The Principles.—The central ideas of scientific management can, perhaps, be more easily held in mind by giving them brief connected statement. Such statement exhibits the general significance of the movement, and gives more carrying power to the ideas than they would have if considered separately.

1. The leading idea of scientific management is, without any doubt, that the conduct of business is a proper subject for scientific research; and that the time has arrived when no management can longer be considered first-class which does not, by thoroughgoing and systematic research, discover the most efficient equipment and methods, and take the necessary steps to install and maintain them. "Both sides," said Frederick W.

[1] Ibid , Vol. II, p. 345.

Taylor, "must recognize as essential the substitution of exact scientific investigation and knowledge for the old individual judgment and opinion, either of the workman or the boss, in all matters relating to the work done in the establishment." [1]

2. Scientific management is a managerial aid to production. It emphasises both management and production: and in both takes the emphasis off the distribution of products between labor and capital. "The great revolution," says Taylor, "that takes place in the mental attitude of the two parties under scientific management is that both sides take their eyes off the division of the surplus as the all-important matter, and together turn their attention toward increasing the size of the surplus." [2]

3. Management must definitely hold itself responsible for developing a science of production, for expressing this science adequately in the working environment which it provides and in the activities of its service departments, for selecting and training the worker, and for making certain by supervision that the worker and the agencies provided unite efficiently in the productive process. "By far the greater gain," says Taylor, "under scientific management comes from the new, the very great and the extraordinary burdens and duties which are voluntarily assumed by those on the management's side." [3]

4 A distinction is to be drawn between planning and execution; and all execution is to be adequately planned for in advance.

5. Control is to be exercised by means of a process of standardization. Standards expressing the desired condition of equipment and the desired methods of procedure are to be drawn up; and standardization is to be achieved by bringing equipment and methods up to these standards and maintaining them there.

6. The records of performance should be such as completely to individualize responsibility, and all rewards should be apportioned on the basis of individual performance.

Ex-Secretary of Commerce W. C. Redfield has summarized the movement in greater detail as follows:

"Disclaiming attachment to any particular system or ex-

[1] Frederick W Taylor, Frank B. Copley, N Y Harper & Brothers, 1923, Vol I, p 12

[2] Ibid, Vol I, p 11.

[3] Ibid, Vol I, p. 12.

ponent of efficiency, the following elements may be said to be clear in all that is proposed in behalf of the alleged new industrial gospel.

" Close cooperation and sympathy between the management and the workmen. This is foremost and basic. If it is not realized that this *is* foremost and basic, the subject is completely misapprehended.

" The standardization of equipment and accessories throughout the shop

" The systematizing of work in operation, of the care, maintenance and issue of materials and tools, and the careful routing of all orders while passing through the works.

" The planning in advance of the work for each machine, and furnishing tools, fixtures, and materials ready to the hand of the workman before needed, so that delays between operations are cut out.

" The study of the actual time occupied by each element or movement of every operation, in order to determine the correct time required for it, and to save waste energy.

" The determination in time study of the proper allowance for rest, necessary delays, or interruptions of work.

" The fixing of standard time for doing work, based upon the aforesaid studies, and the careful personal instruction of workmen in the best and easiest methods of working.

" The payment usually to the workman of a bonus or premium, based upon his doing the work in a certain relation to the standard time."[1]

Mr. Harrington Emerson has stated the principles of efficiency, in twelve points 1. Definite plans and ideals. 2 Supernal common sense 3 Competent guidance. 4 Discipline. 5 The fair deal. 6 Dispatching 7. Reliable, immediate, and adequate records. 8 Determination of standards 9. Standard practice instructions. 10 Standardized conditions. 11 Standardized operations 12. Efficiency reward.[2]

Later History.—The pioneer period of scientific management

[1] The New Industrial Day, William C Redfield, N Y, 1912 Century Co, pp. 176–177

[2] The Twelve Principles of Efficiency, Harrington Emerson, N Y, 1912. Engineering Magazine Co

comprises the two decades between 1880 and 1900. A year after the first date Frederick W Taylor began to make time studies at the Midvale Steel plant A year after the latter date he severed his connection with the Bethlehem Steel Company, and retired from money-making activities During this period the system was being quietly worked out with no more publicity than the reading of several papers by H. R. Towne, F. A. Halsey and F W. Taylor before the American Society of Mechanical Engineers.

The middle period of the history is the decade 1900–1910. During this time interest rapidly increased, especially among engineers, while the courses in business administration now first introduced in American universities provided a new source of inquiries About a dozen books bearing on efficiency in industry can be named which appeared in this period. There then began to be a demand for experts to install the system in manufacturing establishments and in government shipyards and arsenals

This period was ended by the rate hearings of the eastern railroads before the Interstate Commerce Commission in 1910 In these hearings Mr Louis D Brandeis, now justice of the U S Supreme Court, representing an organization of eastern shippers, presented the argument that American railways would not need rate increases if they adopted the methods of scientific management. In particular, at this time, an estimate made by Mr. Harrington Emerson that the railroads might save $1,000,000 per day in operating expenses, by introducing efficiency methods attracted much public attention and aroused lively debate The newspapers and magazines gave space to the new system As many books on industrial efficiency appeared in the year 1912 alone as in the entire decade of 1900–1910. Societies were formed for the study of efficiency. There was keen demand among business executives for information. and in answer to it the profession of efficiency expert was quickly launched, and an army of more or less inadequately prepared persons appeared ready to install wonderworking improvements Since that time discrimination between the genuine and the imitation has been difficult.

This publicity aroused the leaders of organized labor. Pressure was brought to hear upon Congress which led to an investi-

gation by a committee of the House of Representatives in 1912 [1] From 1914 on, for several years Congress attached riders to appropriation bills prohibiting the use of government money for time and motion studies or for premiums or bonuses to wage earners, except bonuses for suggestions.

Opposed as Destructive of the Worker's Initiative.—The leading objection advanced by the representatives of organized labor against scientific management is that it tends to stifle the initiative of the worker, to eliminate the skilled crafts, to monopolize knowledge, and to condemn the worker to a life of monotony. It may be granted that scientific management lessens the range of activities of an average worker by performing many tasks for him which he formerly did for himself, such as grinding his tools; and deprives him of liberties which he formerly enjoyed, such as doing the work in a variety of ways and at a variety of speeds It is the latest step in the long process of the division of labor.

However, we must not picture to ourselves the previous condition of the average worker as one of productive initiative. Professor Charles S Myers, Director of the Psychological Laboratory of Cambridge University, England, after an investigation of scientific management, said: "We must remember that the worker, whether trained in motion study or not, will ultimately fall into *some* habitual method of procedure. The training of a new worker merely shows him one of the most economical methods and prevents in him the formation of bad habits. It need not turn him into a machine any more than if he were left to his own devices." [2]

The stagnant condition of the average shop was referred to at the beginning of the last chapter. These conditions, where labor has had things so largely in its own hands, do not impart much strength to the argument for preserving a wide and indefinite range of activities within which to allow the laborer to wander Men with initiative fitting them to experiment with shop methods and to devise shop equipment, appear among wage earners; but they presently rise out of that class to occupations where

[1] Hearings before the House of Representatives Special Committee on the Taylor and Other Systems of Shop Management Washington, Government Printing Office, 1912 Three volumes

[2] Mind and Work, Charles S. Myers, London and N Y. Putnam, 1921, p. 20.

their talents can be utilized In the average shop the method is ordinary: under scientific management it is the best attainable The superior method is certainly no bar to development

In the ordinary shop men are for the greater part of their time employed on tasks beneath them in quality, while the thought rambles in unproductive woolgathering; in an efficiency shop the aim is to keep men upon the highest kind of work of which they are capable. This concentration of faculties is favorable to growth In the average shop there is little instruction from persons of superior knowledge, and the processes drift along at the comfortable level of the average mind under scientific management the operatives are intimately associated with a group of instructors who explain and demonstrate the best methods, as in a training school; and they are furnished with carefully prepared instruction sheets which are virtually the pages of a textbook upon the art in which they are engaged Surely such a contact between higher and lower is not deadening It can safely be said that more thinking is done in connection with scientific management than any other system of production ever devised, and that a higher ratio of thinkers to mere " hands " is required to operate it than any other

When it comes to the recognition of the exceptional talent which appears among workmen by giving promotion, no establishments are so favorably organized as those with functional foremanship, for none have such a large corps of subordinate officers and special foremen to be recruited from the ranks. As is well known, the chief administrative bar, in ordinary establishments, to the making of suggestions by operatives is the general foreman, who is too busy to welcome criticisms from the force, who quickly gains the idea that a thinking workman is trying to make a showing to get his job, and whose uncurbed power over hiring and discharge makes his enmity fatal to an employee The plan of functional foremanship was the first one to remove the power of arbitrary discharge from the foreman In so doing it anticipated modern practice in employment management

Under scientific management the attention of the workman is sharply drawn to his task. He entertains a new respect for it, by learning that it is a worthy object of study, and that it is pos-

sible to bring out of it an unsuspected fine art The standards under scientific management are not static but progressive No other management is so ready to recognize an improvement when offered, for none has worked so hard to make improvements. And no other type of management can so promptly and completely utilize a good suggestion, for none has the system by which the new idea can be so quickly installed as the standard and applied to every case which pertains to it

Scientific management imposes only one bar to suggestion, and that is the ancient rule recognized in every fine art and applied in every scientifically controlled profession, namely, that no one shall presume to revolutionize methods who has not demonstrated his mastery of the method already in use. The purpose of the rule is to defend the precious body of accepted knowledge from violent hands, and avoid the perpetual uproar as to methods which would ensue if attention were given to every one who pretended to a grasp of fundamental principles.

Opposed as Autocratic.—It has been charged by union representatives that scientific management is undemocratic, that it forces the worker to depend upon the employer's conception of fairness, and gives the worker no voice in hiring or discharge, in setting the task, in determining the wage rate, or determining the general conditions of employment. It should be explained that, in union circles, employers who do not accept a union-dictated stint or day's work, nor subscribe to the union rate of wages to be paid indiscriminately to all the workers of an organized craft, and do not enter into a contract with the unions covering these and many other matters, are described as "undemocratic," "arbitrary," "autocratic," "robbing the worker of his rightful protection," and "engaged in reducing the worker to a condition of serfdom."

Understanding these terms in this special and limited sense, it may be granted that scientific management is a normal case of operation under the capitalistic entrepreneur system, which system gives the opportunity to any one who will provide the material agencies and the administration for production, to assume the responsibilities of management, and invite the cooperation of workers: all this being under the free rule that the

worker assumes no responsibility further than that of following orders, and can leave at will, and the stern rule that if the management is not successful the capital will be lost.

Scientific management is a capital-proposed improvement, for no other reason than that labor has not taken the initiative in proposing it It may be freely granted, however, that these agencies are beyond the ability of workers or the general officers of unions to devise and install: specialists and experts must be employed.

Scientific management cannot produce its characteristic efficient results under a system of flat rates of production and reward within each organized craft, and with a variety of conditions and processes of production subject to the hazard of agreement in conference with organizations whose policies are influenced by the politics of a campaign for power extending far beyond the boundaries of the individual plant. Scientific management depends upon the discovery of the proper method and pace by investigation; and the energizing of all participants by rewards proportional to individual accomplishments. If union organizations can subscribe to such policies of operation, there is no reason why the experts employed should not be jointly hired and paid by the union and the employer. Capital interests can operate an industry, or labor interests can operate an industry; but the two cannot do so jointly unless there is a considerable degree of compatibility as to the basis. A joint plan of employers and unions to determine standards of production, by means of time studies, was carried out in the ladies' garment industry of Cleveland in 1922, under the supervision of an engineer, paid jointly by the unions and the manufacturer's association. This was in connection with the Cleveland Plan of guaranteed employment

Opposed as Liable to Misuse.—Scientific management has been criticized by labor leaders on the ground that "it may be used unscrupulously to the detriment of workers, and offers no guarantee against the abuse of its professed principles and practices." This is not an argument against scientific management alone, but against any scientific instrumentality whatsoever. Efficient agencies are efficient in misuse as in use. The danger of misuse does exist. It exists here as it does at every

step in progress which endows the human hand and the human brain with instruments of increased potency

While it is not a positive guarantee of right use, it is in the nature of a tendency toward it that the more refined and scientific the nature of an agency the more its use will be confined to men of education, whose minds are normal and orderly, who have learned to enforce discipline upon their own passions, and who aspire to broadminded and just ideals. The managements which can install and operate a fine system are likely to be managements of standing in the industrial community, and not apt to adopt a set of principles and then act in systematic violation of them.

Again, there is a wholesome tendency in any system which lays special emphasis upon thorough and scientific investigation, and which erects special agencies to keep watch of performance, for such a system is sure, sooner or later, to accumulate records which will reveal the true significance of every health-destroying condition and every policy which breeds the sense of injustice It may at the start be crude, but it is bound to improve. "Let the light shine," said Erasmus, "and the darkness will disappear of itself." An illustration of this, under scientific management, is the manner in which the study of the performance of individual machines and work places led to the conception of machine-hour costs, and this led to the realization of the heavy burden of idle time, and this to a protest against charging as a true cost of production the cost of seasonal idle periods, and this again to efforts to avoid periods of unemployment and to regularize employment throughout the year.

The experience of industry shows that, in the application of any new agency, good uses vastly predominate over bad ones. If we believe that the majority of people are fair-minded, as those labor leaders who speak so much of industrial democracy certainly must do, we need have no fear of general results.

The Underlying Cause of Opposition.—So varied, extreme, and mutually incompatible are the charges which have been made against scientific management by organized labor, that the series as a whole paints an unbelievable picture of human villainy In short, the series as a whole defeats its purpose as argument. The series, however, is a sufficient evidence of an underlying

attitude of hostility. Is there good ground for such hostility? It seems to the writer that such ground is not far to seek Both labor and scientific management propose as the general objective the public welfare. but they propose to reach it by radically different paths.

Organized labor is striving to develop a solidarity and sense of common cause in the ranks of labor. To do this it, as far as possible, suppresses individual or group aims, and replaces them with common aims. It eliminates the individual wage rate by enforcing the union standard rate. It emphasizes union hours and union working conditions. This is an entirely intelligent policy Its immediate aim is not production but a strong union. The unionist looks with cold eye, even upon benefits to the wage earner, if they come through sources independent of the union, and if they tend to divorce the interest of the wage earner from his union

Scientific management, by its high wages and dependable working conditions, ties the wage earner to his employer. By selecting, placing, promoting, and paying strictly on the basis of individual achievement, it tends to weaken the bond between individual wage earners By achieving benefits for its employees beyond what other employers give, the scientific management plant by so much differentiates the scientific management worker from the mass of workers. By giving wages higher than the union rate, and fixing hours shorter than the union schedule, and providing working conditions better than the union standards, scientific management cancels the sense of obligation in its employees to the unions.

There exists, therefore, a fundamental difference of immediate aim Should progress be by increasing the power of the unions and, by passing through union prosperity, achieve general prosperity? Or should it be by developing examples of ideal individual industrial initiative and, through the diffusion of these methods, achieve the public welfare? It seems reasonable to say that progress should be made in both ways. There are employers so gifted that they should be given freedom to make a contribution to progress, which can be had in no other way There are other employers so contemptible and dangerous that the only safety for the wage earner lies in the public law and the powerful

union. "From 10 per cent to 25 per cent of American employers," says Professor John R. Commons, "may be said to be so far ahead of the game that trade unions cannot reach them. Conditions are better, wages are better, security is better, than unions can actually deliver to their members. The other 75 per cent to 90 per cent are backward, either on account of inefficiency, competition, or greed, and only the big stick of unionism or legislation can bring them up to the level of the 10 per cent or the 25 per cent."[1]

Conclusion.—Scientific management appeared, historically, toward the close of the period of the great inventions and the great captains of industry, when it was possible to take attention off equipment and center it upon administration; and when administration could be considered not as the personal methods of the proprietor merely, but as an art ruled by principles to which experts could subscribe. And it came practically at the beginning of engineering as a profession followed by men with systematic training The contribution of scientific management constitutes a sort of transitional movement or bridge from the earlier period, which looked upon production chiefly as a matter of equipment and processes, to this later day, when it appears to be quite as much a question of adjusting human relationships.

It would be a mistake to identify scientific management as equivalent to the entire movement to introduce science and system into management. It by no means created a complete science of administration. Indeed, but one of its founders—Harrington Emerson—was widely familiar with the pure theory of administration. But it has made very important contributions—so important that industrial administration before its advent now seems like ancient history,—and it is desirable to have a name by which to designate them. More and more these contributions tend to dissolve into the general stream of progress, and lose their distinctiveness of origin.

[1] Industrial Government, John R Commons and Others, N. Y. Macmillan, 1921, p 263

Problems

Promotion Chances under Scientific Management.—Are not the chances of promotion for a workman lessened, since so many matters are standardized, and he has to exercise independent judgment on a smaller range of matters?

References—Taylor, Scientific Management, pp 104–105, Hoxie, Scientific Management and Labor, pp 92–95

The Wages of the Workman and Scientific Management.—General William Crozier reported the following case from the Watertown Arsenal, as one of the results of the introduction of scientific management "After a time study had been made on a piece of work, the workman, who was an exceptionally fast and skillful man, proceeded to earn a good premium, but upon comparing the cost of the work to the Government, before and after the premium system of payment, it was discovered that the cost was greater afterward than before That is, there was no saving of time and overhead charges to compensate for the increased amount paid to the workman" What do you consider the significance of this case to be?

Scientific Management and Unskilled Labor.—Does not scientific management displace capable all-round mechanics from machine-tending processes, and put in their places cheaper, ignorant men of lower caliber, who have previously been doing unskilled work?

References—Taylor, Shop Management, pp 105–106, 146–147, Hoxie, Scientific Management and Labor, p 16, Gilbreth, Primer of Scientific Management, p 61.

Wages versus Output.—Is it not unfair to teach a worker, under scientific management, to do twice as much work as he did before, and then only pay him, perhaps, a 25 or 50 per cent increase of wages?

References—Taylor, Principles of Scientific Management, pp. 135–138; Taylor, Shop Management, p 131; Gilbreth, Primer of Scientific Management, pp 89–90

Questions Concerning Scientific Management.—A consultant in management has stated that the following questions are the ones most commonly asked by business executives with reference to scientific management

1 "How can you utilize employment methods, or in other words, scientifically select the workman, when you must of necessity, under present conditions, hire every applicant available?

2 "With a constantly great labor overturn in a plant, how can standardized methods of manufacture be applied and maintained?

3 "How can greater production and reduced labor costs be obtained unless you 'drive' the workmen?

4. "Why do not piece rates give a constant labor cost?

5. "Why are not piece rates as fair to the workman as is the 'bonus or efficiency' method?

6 "Why are proper routing and good environment necessary for obtaining high efficiency?

7. "Does not scientific management increase overhead expense?"

Frame answers to these questions based upon the conceptions of an efficient system of scientific management.

Scientific Management and Collective Bargaining.—Is not scientific management a form of industrial autocracy? Is it not a system which will break down the democratic safeguards of the worker? Could not collective bargaining be combined with it?

References—Taylor, Shop Management, pp. 185–190; Hoxie, Scientific Management and Labor, pp 9–10, 17–18; Gilbreth, Primer of Scientific Management, p 89.

Scientific Management: Pro and Contra.—Mr. John P. Frey, a labor leader, in March, 1916, published an article on scientific management in the Shoe Worker's Journal, in which was the following paragraph

"Organized labor has declared that Scientific Management is essentially autocratic, a reversion to industrial autocracy which forces the workers to depend upon the employer's conception of fairness and justice, and limits the democratic safeguards of the workers, that it tends to gather up and to transfer to the management all the traditional knowledge, the judgment and the skill of the workers, and monopolizes their initiative and skill in connection with work; that it ordinarily allows the workman no voice in hiring or discharging, the setting of the task, the determination of the wages, or the general conditions of employment; that it greatly intensifies unnecessary managerial dictation and discipline; tends to prevent the presentation and denies the adequate consideration of grievances and tends to increase the number of shop offenses and the amount of docking and fining, it introduces the spirit of mutual suspicion and contest among the men and thus destroys the solidarity and cooperative spirit of the group; it has refused to deal with the workers except as individuals, it is incompatible with and destructive to unionism; it destroys all the protective rules established by unionism, and, finally, it is incompatible with and destructive to collective bargaining"

In opposition to the above statement consider the following statement by Frederick W Taylor, the founder of scientific management "Scientific management is the essence of industrial democracy. It substitutes the rule of law for arbitrary decisions of foremen, employers and the unions, and treats each worker as an independent personality; it transfers to the workers the traditional craft knowledge which is being lost and destroyed

under current industrial methods, lessens the rigors of shop discipline; promotes a friendly feeling and relation between the management and the men, and among the workers of a shop or group, it gives a voice to both parties—to the workers in the end equal voice with the employer—and substitutes joint obedience to fact and laws for obedience to personal authority No such democracy has ever existed in industry before. Every protest of every workman must be handled by those on the management side and the right or wrong of the complaint must be settled, not by the opinion of either the management or the workman, but by the great code of laws which have been developed and which must satisfy both sides, both can refer only to the arbitrament of science and fact. Scientific management thus makes collective bargainings and trades unionism unnecessary as a means of protection to the workers, but it welcomes the cooperation of unionism "

Compare these statements, and value the points made as to fairness and importance; then draw up two statements, with careful regard for fairness, first, as to the influence of the introduction of scientific management upon the workers in the individual plant concerned, second, as to the influence of scientific management as a movement upon the influence of the policies adopted by the unions with the object of strengthening unionism and, if possible, securing for it dominance in industry.

References.—C B Thompson, Relation of Scientific Management to Labor, Quarterly Journal of Economics, Feb, 1916. Republished in Selected Articles on Modern Industrial Movements, Daniel Bloomfield (Editor), Copley, Frederick W. Taylor, Vol I, pp 187–193, Vol II, pp 420–432, and references in the bibliography attached to this chapter

Scientific Management and the Railways.—Draw from Brandeis, Scientific Management and the Railroads, a statement of the proposal made for the introduction of scientific management in American railways, which was made a portion of the argument against rate advance, in the rate hearings of the eastern carriers in 1910 Select several railway periodicals, which may be considered the leaders of the railway periodical press, and examine the files of those periodicals for the year following October, 1910 Read the articles (editorial and other) upon scientific management, draw off a list of the arguments, and the positions taken, and prepare a report upon the reaction of the railway world to the proposal made by Mr Brandeis and his associates

Scientific Management and the Trade Union Press.—Select several periodicals which may be considered to be the leaders of the trade union press, ascertain the period of most active discussion of scientific management (Oct, 1911–Oct 1912?), and examine the files for one year, drawing off statements of position, and arguments From this prepare a state-

ment of the attitude of trade union publications, at the time, to scientific management

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CHAPTER XIII

FUNCTIONS OF THE GENERAL SUPERINTENDENT OR WORKS MANAGER

The responsibility for manufacturing processes, and a portion at least of the control of the various service departments whose activities are directed specially to the furthering of these processes, devolves upon the highest manufacturing authority in the organization, whom we here designate as the general superintendent or works manager. This executive is influential in selecting the manufacturing plant, and in designing the product it is to place upon the market. He is expected to keep the equipment and the making processes up to the standard, provide an adequate personnel of clerks and operatives, and control operations through a schedule, by means of a system of orders, and frequent inspections and reports.

His functions concern men, materials, equipment and processes. Men he hires, trains, assigns to tasks, superintends, disciplines, remunerates, and discharges, protecting them from accidents, and utilizing their labors in an environment of proper working conditions. Equipment he selects or designs, builds or buys, arranges, operates, repairs, protects from theft, vandalism, fire, and the elements, finally consigning it to the scrapheap. Materials and supplies he selects, tests, purchases, stores, and utilizes. Processes he devises, tests, introduces, and supervises. He is responsible for whatever is comprised in the particular branch of the manufacturing art at the time and place.

In all of this work he is aided by the specialists of the company, who more and more establish themselves in service departments, such as those having to do with design, research, purchasing, stock, tools, employment management, accounts, traffic, etc. The planning department will bring together many of his direct

subordinates. Through it, as well as by direct contacts, he will guide and sustain the foremen who are his lieutenants in the shops.

The Foremen.—At his best, the foreman is about the most wholesome all-round man in the modern industrial organization. He is almost always a member of "The Old Guard" of the establishment: and he represents the old-fashioned type of craftsman, but developed by executive responsibilities.

The foreman is the works manager's sergeant. To him the manager looks to keep everything going smoothly in the shop on schedule, to maintain discipline, train apprentices and green hands, rate his men and recommend changes of pay or work on the basis of individual records, keep a sharp eye on tool kits left with machines and all small supplies, inspect spoiled work, scrap, and waste, and keep them within reasonable limits, handle emergency changes of plan, suggest improvements, and interpret and enforce company policies.

Since employees see more of the foremen than of all other executives combined, it is not surprising that many grievances have their origin in the shortcomings of foremen. Andrew Carnegie is reported to have said that all strikes start with poor foremanship. Mr. John D. Rockefeller, Jr., has said: "Experience shows that the vast majority of difficulties which occur in an industry arise between workmen and the subordinate officers who are in daily contact with them." [1] Mr. John Golden, president of the United Textile Workers of America, was asked what besides wages commanded the most attention from the two or three hundred thousand men in his organization. His prompt answer was: "The autocracy of the minor officials, including the foremen." [2] From this situation has arisen the desire of organized labor for the privilege of electing the shop foremen; a demand illustrated by the resolution which was presented, but not passed, at the June, 1919, convention of the American Federation of Labor, which provided: "That . . . the workers in any industry shall have the privilege and are en-

[1] Workmen's Representation in Industrial Government, E J. Miller, Urbana The Univ. of Ill, 1922, p. 90

[2] Bulletin of the Taylor Society, N Y, February, 1920, Vol. V, No 1, p 47.

couraged to demand the right to elect the foremen under whom they shall work by a majority vote of the entire force of the employees engaged in that industry."

Improvement in foremanizing is being sought in two ways: by relieving the foreman of duties, and by his education The developing of specialists involves not only the relief provided in the introduction of the planning room of scientific management, but the continuation of the program of drafting off shop functions into service departments, which has been going on since colonial times. This movement, prior to or contemporaneously with scientific management, had taken out designing, purchasing, traffic, shipping, cost accounting, tool storage, and time keeping It has since developed the employment manager, as the proper officer to handle final responsibility pertaining to employee relations

Parallel with this movement is another which makes of the foreman a supervising executive, and gives him subordinates who are to him as corporals are to sergeants. These assistant foremen or leading hands are, in some notable automobile factories, called "job setters." The job setter is put in charge of a battery of machines of like character, which are regularly manned by unskilled laborers The job setter moves from place to place, on a schedule, arriving at each machine in time to assist the operative in taking out work, setting up new work, changing tools, or making important machine adjustments. It is argued in favor of the plan that it economizes skill by allowing the use of cheaper men for routine work at machines, that it concentrates responsibility for the mechanical condition of equipment upon a small percentage of the working force, and that it relieves the foreman.

The education of the foreman, as a national movement, had its rise at the close of the World War when, as a result of the dilution of skill, and the necessity of energetic Americanization, it was realized that the foreman is the central pivot about which swing vital problems, not only of industry, but of society. Regular programs of foreman training are now being carried on by many of the larger manufacturing organizations. These programs have to do not only with shop practice, but with industrial relations, the work of other departments of the business,

company policies, the elements of business organization and management, and economic problems

Care of Machinery and Equipment.—The manufacturing equipment is intrusted to the works manager. He must depend upon his foremen, inspectors, repair men, and janitors to see that it is properly used, and is maintained in standard condition Foremen will instruct operatives as to the safe limit of tightness for threaded parts to avoid stripping threads, as to the oiling points and the oiling schedule, calling attention to destructive methods such as striking the metal parts of machinery with hard hammers, using wrenches as hammers, etc. Inspectors will report on all fire escapes, fire hose, the insulation of pipes and wires, etc. They will inspect for safety; and will instruct the foremen as to the critical points to watch for accident hazard and for needed repairs, at each work place. The machine repair service will make adjustments to compensate for wear, specifying change of lubricant, when necessary, as fits are loosened by wear. This service will keep a record of the nature of breakdowns, and the expense of repairs for each machine A Ford rule is, "Maintain complete record of breakdowns, thus locating weak points and preventing recurrence by insistence on proper changes when buying more equipment of the same type"

The proper care of equipment may be enforced by strict supervision; but it can be more certainly achieved by combining with it education which changes the attitude of everyone to respect for the machinery and buildings provided. A group of ruined small tools, used in a department, can be gathered from the tool room and from scrap, and wired to a bulletin board, with labels giving the name of the tool, the original cost, the average life, the mistake which ruined the particular specimen, and the number of such tools used in a year

"Man is a tool-using animal," said Thomas Carlyle. "Weak in himself, and of small stature, he stands on a basis, at most of the fattest-soled, of some half-square foot, insecurely enough; has to straddle out his legs, lest the very wind supplant him Feeblest of bipeds! Three quintals are a crushing load for him, the steer of the meadow tosses him aloft, like a waste rag. Nevertheless, he can use Tools, can devise Tools with these, granite mountain melts into light dust before him; seas are his smooth

highway, winds and fire his unwearying steeds. Nowhere do you find him without Tools; without Tools he is nothing, with Tools he is all."

To many workmen the machinery with which they are sursounded simply represents "capital": a thing owned by a body of unknown persons called stockholders; a mere tangible form which represents someone's money. Machines do, indeed, represent a capital which someone has built up by earning and saving, and has had the faith to invest. But they also represent a power of production, and a means of making things cheaply and well, with a minimum of the burden of physical toil resting upon the wage earner. They are at once a means of saving labor and a means of providing more of the good things of life for everybody in the community. No one has so great an interest in using machinery well, and in encouraging the further development and use of it as the wage earner, for it is by the use of machinery, largely, that the present generation has escaped the hardships of past ages, and secured the many comforts which mark the life of the average man.

To gain the modern ease and economy, a great equipment has become necessary; and to many people this equipment seems a threatening thing. It sometimes seems as if men were becoming secondary considerations in modern industry, and machinery the primary factor.

It is true that, whereas direct labor was once a larger proportion of the cost of a manufactured article than factory burden or "expense" (which includes the cost of owning and operating machinery), the proportions have now been changed in many industries, and "expense" is a larger factor than labor. But what is the result of this? In the days of the small, modestly-equipped shop, if trade were poor, the manufacturer could close down his plant, and when he had thus cut off his bills for direct labor by discharging his men, could feel that the loss on account of idle equipment could be disregarded. But to-day a shut-down cuts off only the smaller of the two items of cost, and leaves the larger one—the interest charge and the depreciation on account of equipment—piling up steadily against him. Consequently, we find that modern managements are making every possible effort to insure continuous employment to their equip-

ment and labor. And this is a great advantage to the wage earner.

What is true of a shut-down on account of a dull season is true of a shut-down on account of a strike And so managements are endeavoring to find some fair way of settling difficulties which will be less costly than the strike. And what is true of the strike is true of absenteeism and tardiness and labor turnover, for these things leave equipment idle or put it into the hands of green operatives. Industry, therefore, cannot afford to disregard the conditions which lead the worker to be absent from his place, whether the cause be sickness or accident or a grievance of some sort. The idle machine calls out loudly, in the language of costs, for its partner, the workman

Design of the Product.—In a general way, the final design of any product tends to be arrived at by obtaining, first, what may be called a theoretical design, either by purchase or from the designing department, and then proceeding to modify this design from the standpoint of the selling departments, and from that of the manufacturing departments It may be confidently asserted that no single individual is competent to mature a design to its finished state The sovereign receipt for adjusting the demands of theoretical design, of good selling design, and of economically made design, is to bring the experts representing the three points of view into conference and submit the proposed product to a refining process in which every characteristic, every line, and surface, and part is considered, one at a time.

It is desirable that the designing department of a works should be kept in intimate touch with the manufacturing shops. The designer should have at hand convenient lists of machines tools and attachments in the shops, with tables showing the limit dimensions and weights of work that can be handled To make manufacturing cost a more tangible thing, lists of expensive shapes, or forms of construction, may be illustrated in parallel columns with substantially equivalent shapes, or forms of construction, which are easily produced. Similarly, tabulations of expensive and inexpensive finishes, or of expensive materials and materials nearly equivalent but less in cost can be made. It will be profitable to require that a designer follow personally in the shops the progress of making his experimental models

If the product be a machine, good design will avoid difficult problems in moulding, and the use of fragile castings It will shun filets of compound curves for machined surfaces, will reduce highly polished surfaces to a minimum, will freely employ the punch press and drop forging processes, will specify standard sizes of bolts, screws, and small parts, and will prescribe work which can be turned out by standard arbors, bores, and tapers. In short, designing should be done in harmony with the economics of production

Use is the supreme test. The consumer sorrowfully gathers much wisdom Designers should not only study their productions in experimental operation, and continue tests to failure, but should study their products away from the plant, in actual use, in the consumer's hands They should gather up discarded and worn-out specimens to ascertain what ended the useful life, and find out why the design fell short of the coordination of "the wonderful one-horse chaise." It is reported that the Ford Motor Company followed the replacement of parts on the Model T car for years, to ascertain where the weak points of design or material were Likewise service work was done in Detroit for years, which yielded valuable information

Standards of Accuracy.—Upon the general superintendent rests the responsibility of maintaining such standards of accuracy as will preserve intact the qualities aimed at in the original design of his product, and will permit easy assembling, and allow of interchangeability of parts

When Isaac Watts was struggling with the first models of his steam engine, he had great trouble to prevent steam from leaking past his piston He used cork, oiled rags, tow, paper, and other things When finally a large engine was constructed, it was impossible to build an 18-inch cylinder and get the longest and shortest diameters nearer together than $\frac{3}{8}$ of an inch It was not until 1774 that John Wilkinson built a boring machine which helped the pioneers over this difficulty So greatly has precision of working increased since that time, that in machine shops of the present day the holding of a dimension within $\frac{1}{2}$ of a thousandth of an inch is a matter of course

The system formerly in use was to inform the foreman what kind of fit was desired—running, sliding, driving, forcing.

shrinking. These terms were variously interpreted in different shops and by different workmen, so that it was necessary to leave the smaller parts a little full, and finish by hand filing and constant trial of assembly. It was a great step in advance when blue prints and written specifications came into use, and the control of dimensions was taken out of the hands of foremen and mechanics and concentrated in the hands of designers and the superintendent. Control is now exercised by indications on the drawings, and by gauges for testing the work. This involves especially such matters as clearance, allowance, and tolerance

Clearance is a quality of dimensions by which two adjacent surfaces stand clear of each other. Allowance is a difference in the dimensions prescribed for two parts to produce a certain quality of fit Tolerance is a departure from dimensions permitted as an unavoidable or unimportant imperfection in workmanship. The nature of a fit will be determined by the combination of allowance and tolerance Upon the drawings the nominal or ideal dimensions will be given Tolerance is then indicated either by the plus or minus method, as 2″ (nominal) $\pm$ 002″, or by double dimensions $\frac{2\ 0025''}{2\ 0020''}$. In general, nominal dimensions will be the mean between the extremes of tolerance; that is to say, plus and minus tolerance will be equal Care must be taken to prevent overlapping of tolerances on parts to be assembled together. The sum of the tolerances on intermediate dimensions must agree with the tolerance permitted on the overall dimension. Eccentricity in cylindrical parts must be recognized and a tolerance fixed. By indicating a large tolerance for unimportant dimensions, and a less one for more particular parts, the time and skill of the shops may be concentrated by the administration upon those parts of the work where they will count for the most.

In the shops the work will be controlled by means of gauges. Formerly but one gauge was used and the quality of the fit was determined by the looseness of the work in the gauge The best practice now is to provide limit gauges for shop use, whose dimensions are slightly inside the limits indicated on the drawings. These gauges must be frequently calibrated by comparison with master gauges, which are intended to represent

quite accurately the limit dimensions. The master gauges must be preserved from wear or misuse by retaining them in the foreman's office, and using them for reference purposes only

The Control of Quality.—There are many ideals in industry. There is the ideal of economy or minimum cost, of speed and promptness, of regularity and dependability: all with many others, merging in the general ideal of service In some ways the noblest of all industrial ideals is that of quality of material and workmanship: not how cheap, nor how soon, but how good. Quality is the characteristic ideal of the master craftsman. It is a maker's rather than a merchant's ideal: and it is the ideal which, in the long run, is most appreciated by the consumer.

The general superintendent and his aids have the task of holding the quality of their products as constant as may be, in spite of the varying state of repair of machinery, or the varying skill and willingness of employees as modified by labor turnover, or the varying qualities of materials which must be worked upon. The conditions for attaining a high standard of quality may be reviewed briefly

(*a*) Good equipment maintained in reliable condition
(*b*) Standardization upon the best process
(*c*) Materials of proper quality, kept uniform by careful purchasing and inspecting
(*d*) Working conditions conducive to a proper spirit.
(*e*) Adequate training of the operative force
(*f*) Prompt records, sufficiently individualized, and sufficiently followed up with remedial measures to create a clear sense of responsibility.
(*g*) The quality of workmanshop made a factor in wage payment and promotion To this may be added that there must be quality in the wage corresponding to the quality wanted in the product. "I asked an iron master," said Emerson, about the slag and cinder in railroad iron—'O,' he said, 'there's always good iron to be had; if there's cinder in the iron, 'tis because there was cinder in the pay' "[1]
(*h*) Quality ideals made widely known throughout the plant, and made interesting by competitive scores and otherwise

[1] Conduct of Life, Ralph Waldo Emerson, Boston, 1898. Houghton Mifflin & Co. Essay, "Considerations by the Way."

(i) Team work throughout the plant: the general administrative officers, the foremen, and the clerks consistently pulling for quality, until operatives become convinced, infected with the spirit informing the place, and join harmoniously in the effort "The quality of any product," said Houston Lowe, "is largely dependent on the spirit of those who make it. The very best way to improve a product is to improve the organization behind it "[1]

The expert in industry is sustained in his work, and has a steady enthusiasm, because he has a background of knowledge out of which have been born the ideals by which he is guided If the foreman would have his men enthusiastic for quality, he must build up such a background. He must explain the advantages of the qualities he desires, comparing good work with bad work, leading back from defects to the errors which produced them. If possible, the apparatus of testing should be brought from the laboratory, and a demonstration made of the way in which tests are carried through It will be better still if simple testing apparatus can be permanently installed in the shop and regularly used. Briefly expressed, the ideal must be made real and familiar. For an account of convincing applications of these methods the reader should examine the writings of Robert B. Wolf.[2]

All work must be confined within certain cost limits A quality ideal for a product is, therefore, a conception relative to and in harmony with a cost ideal. If an operative does work which is too poor in quality, he violates the quality ideal If he does work which is too good in quality, he violates the cost ideal. If the work which is too good is permitted to continue, the operative fixes the quality standard at will, except that the management establishes a minimum by its inspection The

[1] Three Things Learned from 50 Years in One Business, Houston Lowe, American Magazine, Oct, 1919

[2] Nonfinancial Incentives, Robert B. Wolf, N. Y, American Society of Mechanical Engineers, 1918. This is an authoritative paper by the manager of the Spanish River Pulp and Paper Mills (Ltd) of Sault Ste Marie, Ontario, Canada Republished as Chapter XVII in Trade Unionism and Labor Problems, John R Commons, Boston Ginn, 1921, pp. 218–232 See also, The Creative Workman, Robert B Wolf, N Y., Technical Association of the Pulp and Paper Industry, 1918.

doing of work which is too good is one of the recognized methods of nursing a job

Whatever the consumer pays to secure one utility he must make good by denying himself other utilities. The ideal of industry is to accomplish the most at the least cost Because of the variety of utilities which consumers desire, and individual differences in buying power, a great many qualities of product are equally justifiable economically. But an article which will give only a like number and kind of units of utility with another, but at a higher unit-utility cost, is an illogical variant product and uneconomic. An article of parts so proportioned as to durability that one part fails, while the other parts are good for much additional service, unless easy repair or replacement is made possible by the method of construction, and is made practical by service stations or supply parts in dealers' hands, is an uneconomic product.

Inspection.—Among the objects to be attained by a system of inspection of products are, to detect poor materials, to discover defective processes or inadequate apparatus, to sift and educate workmen, to save labor, as in the hand fitting of machine parts at assembly, or the improvement of textile fabrics woven with defective yarns, to avoid the continuation of work on material already spoiled, to ascertain the loss allowance necessary in cost estimates, to escape loss of prestige from the delivery of defective goods to customers, to counteract the influence toward sacrifice of quality inherent in systems of pay based chiefly on output, and to introduce workmanship more prominently as an element in determining pay. Inspection is, therefore, an instrumentality of management possessed of broad utility.

The method of inspection is to discover defects by the examination or test of products, to trace these defects back to their causes, fixing individual responsibility; and to compile records so classified as to cause, machine, process, operator, batch of material, shop, or otherwise, that general tendencies will be revealed, and the management may intelligently direct its efforts toward prevention.

The closeness of inspection will be in proportion to the possible loss which undetected defects may cause It will naturally be searching for automobile parts and for locomotives, railway

cars, railway rails, and the signal oil used by railways for switch lights and block signal lights. Whether it should be terminal inspection or intermediate between processes, will depend upon the probability that additional work will be done on defective pieces, and upon the danger of defective work being covered up by subsequent steps of manufacture. It will usually be wise to examine the first few pieces of a new run.

The process of inspection may be automatic, voluntary, or professional. Automatic inspection occurs where a jig or fixture is made in such a way that work will not fit into it unless the previous steps of manufacture have been correct. Voluntary inspection occurs when men are paid according to the amount of perfect work finished by them, and hence become critical of pieces which will be counted out, and of materials likely to cause them delay This is sometimes called chain inspection. In a famous clothing factory, every operator who finds a defect on a garment, due to the work of a prior operator, receives the price of that operation for the garment. It has been found necessary, however, to make an exception of ripped places, for the temptation was too strong to make a little rip into a bigger one. As this point suggests, chain inspection is likely to breed illwill between operatives. Professional inspection is a function of administration. It tends to pass into the hands of specialists in the measure that defects are subtle or their causes are difficult to trace. Central inspection in specially equipped rooms is most accurate; but when inserted between processes involves the expense of shifting work back and forth.

Inspection may be random, complete, or any combination of the two. Random inspection chooses at random a certain number of units from a lot, and judges the lot on the basis of the results in the cases examined. Complete inspection means the examination of every unit. Combination inspection takes place when in the first part of a run, every piece is inspected until quality appears to be assured, when a change is made to random inspection. If then random inspection uncovers a defect, a change may be made back to complete inspection.

Measurement of Output.—If it is desired to collect a system of unit costs, or to pay men on the basis of performance, ways must be found of measuring the work done. To do this presents

no special problem where a good division of labor exists and conditions are standardized. But where there is variety of task and condition, as in the construction trades, the choice of measure and the administration of it is not easy. For painting and plastering and shingling the square yard may be used to state amounts, but it will mean little unless the quality of the work is determined. In concrete work the cubic contents of a structure can be measured, but such a record will merely summarize the result of handling materials, building and erecting frames, removing forms, placing reenforcing steel, tending the mixer, moving, pouring, and ramming the liquid concrete, and finishing exposed surfaces.

"In engineering construction," Gillette and Dana tell us, "the cubic yard is a very common unit upon which contract prices are based, but the cubic yard itself is frequently a very uncertain unit of performance, for it is a composite of other units. Thus, in rock excavation, there are several distinct operations involved, which may be enumerated as follows: 1, drilling; 2, charging and firing (or blasting); 3, breaking large chunks to suitable sizes; 4, loading into cars, carts, skips, or the like, 5, transporting; 6, dumping."[1] The aim should be to measure elements rather than composites: in mathematical phrase, to measure variables rather than their functions. Hence the measurements sought should be, as far as possible, of elementary performances or single steps of manufacture, rather than of chains of operations.

The work of single persons or gangs or of distinct classes of persons should be chosen rather than that of groups of persons pursuing unlike crafts. Thus, in concrete work, measures may be taken of the loads of sand brought up, the bags of cement mixed, the board feet of framing constructed, the number of standardized and individually keyed forms set up or taken down, the square yards surfaced, etc. In rock excavation account may be taken of the lineal feet of holes drilled, the number of charges exploded, the tons or yards of rock broken up, the amounts of material loaded, unloaded, and carried given distances by given means of transportation.

[1] H P. Gillette and R T. Dana, Cost Keeping and Management Engineering, N Y., 1909, p. 50

In heavy masonry work the individual stones can be measured and marked in the stock yard. A report of the numbers laid each day can then be easily kept by the foreman, from which an accurate idea can be derived as to the cubic yards of work of each gang daily.

Simplification of Assortments.—It has long been a matter of common knowledge that many lines of manufacturing are carrying a heavy burden as a result of the large variety of sizes and designs of product offered and from the persistence of a stream of petty orders for repair parts for an immense variety of half-obsolete mechanisms in the hands of the public. This source of waste was vigorously attacked during the World War by the Conservation Division of the War Industries Board, which through priority of material orders and permitted schedules of production, started a wholesome pruning movement for American catalogs. Since the war, the Fabricated Production Department of the Chamber of Commerce of the United States has carried on a vigorous campaign for simplification.

A few illustrations will serve to make the situation clear. In describing the situation of a corporation manufacturing ammunition, Mr. John M. Bruce says: "One of that concern's lines was making shot-gun shells. They wanted to secure the services of the best motion study expert they could get hold of to speed up the transfer of machines from one kind of loading to another. They said, 'We have eighteen thousand different changes in loads that we sell regularly in our plant here, and every time we change a load to fill an order we have to stop and reset the machine. We have made a study of it and find that our machines are out of use and we are not loading 40 per cent of the time They load only 60 per cent of the time, and they are idle in change 40 per cent of the time. If we could speed them up, we might arrange to cut it down to 20 per cent.'

"Upon inquiry as to how many loads are necessary to cover all the kinds of game that are shot, after figuring out the number of loads and also how many kinds of powder were necessary and the other things that a customer had a legitimate reason for buying, the result was less than a hundred loads instead of eighteen thousand. Then a basis was worked out by which a customer could get the standard loads at the standard price,

paying a little excess for the special loads They put five machines to work on the special loads, and the other three hundred and ninety-six machines on standard loads, set permanently, so many different machines to each load, according to the class of loads that were wanted. So, instead of doing a lot of work to save time in making the changes, they did something else, they eliminated the changes."[1]

Mr. Howard Coonley, President of the Walworth Manufacturing Company of Boston, a corporation manufacturing valves and pipe fittings, has related that when a survey was made it was found that they were making 17,000 distinct products. An analysis of the order books showed that from 60 to 65 per cent of their business was on 610 items. By concentrating sales effort on these items they have greatly improved manufacturing conditions.

A concern in the men's ready-to-wear trade was offering to customers 22 models of sack suits and 20 models of overcoats, each in over 1000 styles of cloth. They found that one model of suit and one model of overcoat accounted for about one-half of the business, while 9 models of suits accounted for 95 per cent of the suit business and 8 models of overcoats accounted for 94 per cent of the overcoat sales.

Melvin T. Copeland describes the case of a manufacturer of farm wagons who reduced the variety of front and rear gears from 1736 to 16, without sacrificing any essential size or style He tells, likewise, of the standardization wrought among the manufacturers of pocket knives, who have reduced catalog numbers from 6000 to 100 for each manufacturer.[2]

In the last few years many trade committees have studied the problem of simplification, and many trades have taken joint action The varieties of flat metal lath have been reduced from 80 to 10 The sizes of milk bottle caps have been reduced from 10 to 1 size Woven wire fence, formerly made in 552 sizes and types, is now simplified to 69. One of the largest corporations making agricultural implements, after making a complete study

[1] Building a Sales Policy, John M Bruce, Annals of Am Acad Pol and Social Science, Sept, 1919, p 293

[2] Standardization of Products, Melvin T Copeland, Bulletin of the Taylor Society, Vol 6, No 2, April, 1921, pp 55–59

of their practice, reduced the varieties of steel purchased from 73 to 38, cut down the styles of corn shredders from 12 to 4, of spreaders from 42 to 2, of disk harrows from 286 to 68, and of plows from 398 to 271 Tile manufacturers have cut down from 1351 items to 454 The manufacturers of bed blankets have agreed to reduce sizes from 72 to 12—6 sizes for single beds and 6 sizes for double beds. Paving bricks have dropped from 66 varieties to 7 Under the Federal Standard Containers Act, 31 sizes of grape baskets have been reduced to 3 The plumbing goods manufacturers, through a committee in 1923–24, found that in the one item of traps there were 1114 styles and sizes The order books of the trade showed that 90 per cent of all the business centered on 119 numbers, so that, for 10 per cent of the trade, 90 per cent of the varieties were being made and carried in stock It was finally agreed that 76 numbers would entirely cover consumer's requirements.

The causes which have led to this useless and expensive variety of products are various One is the natural evolution of design Old models have not been promptly enough dropped, and the public is still using equipment in every stage of obsolescence Another cause is the desire of sales departments to carry full assortments, and to cater to the customer's demands, and to have new designs with "talking points," or to have something different from competitors, so as to be able to emphasize "exclusive features," or to evade the force of direct price comparisons Among minor causes may be mentioned provincial demands for old styles, the peculiar requirements of the foreign-born population, and skin-grades, which are goods manufactured just below standard in size or quality to be sold by dealers to the public as standard

Simplification, or standardization, or "system in scrapping the obsolete," will work economy, by permitting longer runs in production, with less idle time for equipment. It will mean fewer varieties of material and products in stock, with a swifter flow of stock and prompter deliveries. It will confer benefits upon jobbers and retailers, will strip off a mass of nonsense from selling, and will promote truth and common sense in advertising

A portion of the problem of simplification concerns the service which the manufacturer of a mechanism constructed under the

system of interchangeable parts renders to the users of his product by supplying repair parts. How long ought a manufacturer to continue this service? One manufacturer of stoves has decided as follows: "It is our policy to be able to furnish all parts of stoves that have been out of the catalog for five years. For the second five years all parts except those which would be wanted only because of breakage in shipping; for the third five years, we furnish only such parts as are likely to burn out or crack in use. After 20 years we furnish only fire-box parts."

Another manufacturer whose product is factory machinery, argued that as all manufacturers should charge a proper rate of depreciation, the supplier's duty to afford repair parts might properly be said to terminate when the book value of the machine had been entirely charged off. As depreciation rates on machinery vary from 5 to 10 per cent per annum, flat rates, the replacement service might continue from 10 to 20 years. Some manufacturers tabulate the demand for repair parts according to types of machines, and when the business becomes so small as to be unprofitable, discontinue the service, or thereafter make an extra charge for parts made on special order. Some manufacturers take in enough old models in exchange for new ones to be able, by stripping the old machines, to satisfy the demand for repair parts.

Budget Control.—The control of operations through a budget is one of the many applications of the principle of standardization, to which reference was made in Chapter IX on The Rules of Administration. Budget planning starts with the setting up of an object to be achieved by a business during the next twelve months' period. This objective may be a given profit, or a total volume of sales, or a certain production. The next step, which may be taken by a comptroller, or a company treasurer, is to break up the chief aim into its component parts, divide the program into a series of proposed accomplishments for each month, and assign to each department its particular part in the program The departmental estimates are distributed to the department heads. The latter continue the analytical process, breaking up the functions assigned to them into their elements, estimating the requirements in the way of men, equipment, and materials.

Sales will be analyzed by products and divided into quotas for each territory. The financial requirements will be shown by a comparison of schedules of proposed billings and purchases, and anticipated cash receipts and disbursements From them can be inferred a certain program of borrowings and liquidations extending throughout the year. When each department head has completed his calculations, a series of conferences is held, in which the estimates are revised, until they are at last ready to be promulgated as the binding program of the ensuing year

As the program develops throughout the year, frequent reports of actual results are made, and these are compared with the requirement of the budget for the period, and for the year to date. If there is deficiency, explanations are required, and special steps are taken to bring performance back into agreement with the budget If there is excess performance, the budget is revised

Advantages of Budget Control.—When budget control is not attempted with a degree of inflexibility unsuited to the nature of the business, and when it is not made the means of too great a degree of centralization, it brings a variety of benefits. So many and so important are these benefits, that many users of budgets consider them to be the most fruitful agency which a business can employ in the control of its affairs.

The preparation of a budget is an intensive process of planning ahead Past experience is examined to show what the normal rate of growth has been And the future is studied by means of general and special business barometers. As the result of working to a forecast, inventories can be better controlled, for requirements can be anticipated by purchases during low price periods The financing is made simpler because the period of liquidation is better known at the time of borrowing The study of seasonal variations suggests the possibility of regularizing, by producing for stock when current requirements are small. A more even operation of the plant cuts many costs, lessens unemployment, reduces labor turnover, attracts a better class of employees, and insures more prompt and full shipments to customers

The analysis incident to dividing a budget into its elements, serves also to divide into manageable parts the problem of carrying through the proposed plan. As the year's program is divided into a series of brief periods, efforts are divided into short heats,

and there is always an immediate and definite goal in sight Each officer has the satisfying feeling that he knows exactly where he is in his work, and what remains to be done.

In carrying out a budget program, the different departments are brought into frequent comparison, and the power of one to retard another is vividly realized. From this it results that there is a better coordination, and a more intelligent and active cooperation. To facilitate comparison, all information in reports must be grouped precisely as the items in the budget are classified. The record keeping activities throughout the business are thus harmonized into a system. Costs are no longer merely history: they are made data for current control.

Problems

A Usual Case of Foremanizing.—In a certain establishment, the system of management with reference to the work of the foremen had not been changed for many years There was one foreman in charge of each department. Some of the departments were small, but in other cases, where new lines of manufacture had been added from time to time, the foremen presided over departments so large that they almost amounted to factories in themselves The general manager kept in touch with the foremen by telephone, and by frequent conversations, advising them of the new orders which had come in, of the delivery dates which the salesmen had agreed to, and hence as to the work which was cut out for each department for the immediate future.

The foremen have such a variety of responsibilities that they depend upon the workers to a considerable extent to keep things going, without demanding too much of their time Every shop contains men who are almost as well able to plan a job as the foreman himself On these men rests a good deal of responsibility whenever a new job is being worked out. Care is taken in hiring to hire men, as far as possible, who have had enough experience to take reasonable care of themselves This makes the labor costs high and the foremen feel that they have a right to ask a good deal from men who are drawing large wages from the company.

If a question arises in the progress of any job, the workmen consult with the foremen If the foreman does not know, he consults the superintendent The workman is responsible for selecting and preparing his own tools. If necessary, tools can be borrowed from machines not in operation. The workman also largely determines his own methods of working. It is believed that there are a dozen ways of working, one

as good as another. Besides this, if a man chooses a method for himself, it is felt that this method is likely to be the best way for him As the men have had previous experience in other plants, a variety of methods in use may lead to comparisons and improvements

Will you criticize the methods used in the management of this establishment? Suggest any changes you would make, and any new agencies you would wish to install

Bringing the Foremen Together.—In an establishment in Chicago, the foremen of the various shops were so busy in their individual departments that they seldom saw anything of each other. Each man ran his own department quite independently—almost as if he were running a business of his own. Some of these men found much to blame in other foremen, because of delays and various occurrences which caused inconvenience In fact, there was a quite general feeling of hostility among them This went so far that some of the men even took a secret pleasure in obstructing each other in inconspicuous ways.

As a result of an unpleasant experience, in which the general manager was involved, it was determined to make an effort to create a more friendly feeling, and get better teamwork So a nearby hall was hired, an order was given to a caterer, and the foremen and their wives were invited to an evening dinner, with the compliments of the Company. The chief officers were there, and most of the foremen came After the dinner, there were a number of speeches The sales manager especially endeavored to break up the stiffness and work up enthusiasm.

At the close of the program, it was announced that the dinner was to inaugurate a new policy; and that thereafter there would be a dinner every three months

What do you think of the plan? If you criticise it, what would you do to bring about a better feeling, and inaugurate real teamwork between the departments?

The Foreman as a Union Officer.—Mr G D H Cole, an English trade union officer, in his book, The Payment of Wages, London, 1918, pp 76–78, says: "Scientific management tends to make more impassable the gulf between Labour and Management In place of promotion from the ranks of the workers, Scientific Management would find its foremen by special selection, and train them largely away from the workshop In this way the foreman would come to have less of the Labour and more of the employer's point of view, and would become, far more than now, a new class of dependents of Capitalism For one who believes, like myself, that one of the next steps for Trade Unionism in its gradual assumption of control over industry, would be to take altogether out of the employer's hands and invest in the Trade Union the appointment of foremen and the organization of the workshop, this

appears as a counter-move on the part of Capitalism to remove the foreman from the possibility of control by Labour"

What consequences do you think would follow, with reference to output, employment policies, discipline, the treatment of non-union employees, etc, if the foremen of an establishment were chosen and installed by a local labor union?

The Management of Repairs and Upkeep.—"In one factory (in the garment trades) 1100 operatives were served by two machinists, who were kept on the jump from morning until night making emergency makeshift repairs out in the shop, while the workers look on and others, idle, await their turns They state that they do not have time to take a machine into their repair shop and give it a proper overhauling Nor does their repair shop contain a single planer, speed lathe or drill press. The sewing machines are in run-down condition. These operatives on piece-work lose production and earning power through frequent breakdowns, the low speeds of their machines, and the interruptions caused by frequent thread breaks that come when the internal mechanism is out of proper adjustment A test in this shop showed that the speed of machines on the same shafts and same operations ranged from 2250 down to 1750 stitches per minute, whereas, in another establishment, the machines went 4000 stitches per minute, Discouragement and dissatisfaction of piece-workers under such conditions lead to labor turnover"

Report a plan for the organization of a proper repair department, and indicate what tests you would employ to determine whether or not it was operating efficiently

Instruments of Precision for the Control of Quality.—Describe the chief instruments of precision employed in controlling the dimensions of fine metal work; and explain the manner of their employment In this report should be included the different kinds of gauges, calipers, vernier calipers, micrometer calipers, surface plates, etc In the case of the vernier caliper and the micrometer caliper, prepare large-scale drawings of the essential parts, to show the manner of construction, so that the description of operation can be illustrated by the diagrams. If possible, secure the loan of a vernier caliper and a micrometer caliper for the purpose of demonstration. The report may be illustrated by mounted cuts selected from the catalogs of manufacturers.

Reference.—Woodworth, "American Tool Making and Interchangeable Mechanism," the advertising pages of engineering periodicals, the catalogs of manufacturers of instruments of precision, etc

Effect of the Evolution of Design.—A young man inherited his father's business. The product manufactured was an engine governor, protected by patents having eleven years yet to run. The location was a small

town, where the employees were capable and loyal, and where the banks had always taken care of the necessary money advances without question A single mill supply jobber took the entire output on a yearly contract, so that there was no selling department The young man, who was a college graduate, had spent very little time in the business Upon taking charge he exercised only a general supervision feeling, not only confidence in, but consideration for, the department heads, who had worked with his father He enjoyed his income of approximately $12,000 a year, using his time in local civic work, travel, etc.

After six years had thus passed, a shock came without warning The jobber who had acted as distributor refused to renew his contract for the next year. Inquiries soon showed that the cause of this refusal was the appearance of a rival governor, which was of similar design, though simpler, which was materially better in finish, and which was offered at a slightly lower price

As funds were not at hand to start law suits, it was decided not to follow the advice of a patent attorney to sue for infringement of design Because of the same lack, plans could not be carried through for rebuilding the factory and inaugurating a different line of manufacture The plant was, therefore, shut down, and the business was destroyed The buildings, grounds, and equipments which stood on the books at $100,000, stood idle for four years, and were finally sold for $20,000

What personal preparation would you have had the young man make for his obvious future occupation? What course would you have had him pursue, after the business came into his hands, with reference to production, design, distribution, and finance?

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CHAPTER XIV

PURCHASING AND STORES DEPARTMENTS

The census of 1919 revealed the fact that the 290,000 manufacturing establishments of the United States paid out during the year $37,376,000,000 for materials, while the total additions of value by reason of manufacture were $25,042,000,000, making the value of the completed products $62,418,000,000. The cost of materials was nearly three times the total sum paid out for salaries and wages; this latter sum being $13,426,000,000. Furthermore, the value of materials is increasing faster than the value added by manufacture These facts make it clear why increasing attention is being given to the economics of the purchasing, preservation, and utilization of materials in manufacturing institutions.

The place of the economics of materials in the scheme of industrial efficiencies is thus presented by Mr. H. B. Twyford. "The first effort usually made to widen the difference between cost and price is to increase the output by encouraging the demand through advertising and salesmanship. When the limit is reached in this direction, recourse is had to investigating reduction of costs. In cost reduction, the principal attack is made on the labor item. In the days of primitive manufacturing, labor and material were the only two items considered in computing costs, but today labor costs frequently hold third place, indirect expense and material being the two which rank ahead of it Efficient methods of reducing these should go hand in hand with the efforts directed at labor costs. To reduce the cost of materials, an effective system of buying is compulsory, if the best results are to be obtained." [1]

General Functions.—The control of materials, in connection with manufacturing, involves the following functions:

[1] Purchasing, H. B. Twyford, N. Y. Van Nostrand Co, 1915, p. 16.

Financing, to provide the ready cash to meet bills for materials purchased, and to provide the permanent capital with which to carry the invoices of raw stock and manufactured product which will be regularly required

Purchasing, to secure a given quality and quantity of material at the minimum cost

Purchasing, to secure the quality of material which will be best adapted to the manufacturing process of the shops, and the consumption process at the hands of customers

Purchasing for time utility, by a schedule sufficiently in advance of the demands of production departments, so that there shall be no delay for lack of materials to work upon

Purchasing for minimum quantity in invoice, by closely adapting the purchase schedule to the production schedule.

Receiving of purchased materials, checking for quantity, and passing invoices for payment

Inspecting and testing to make certain that the qualities ordered have been received.

Stowage, to protect materials physically, and make them accessible, with the minimum of delay and of mistakes in identification, while in the plant but not in process of manufacture

A control system for stores, to enforce personal responsibility for the values represented by materials, upon whatever person obtains possession of them in connection with manufacturing or shipping, and also to facilitate the purchasing schedule

A stores accounting system to charge the cost of materials used correctly to the individual units or lots of product for cost accounting and price fixing purposes, and to determine invoices for proprietorship accounting

A move system for regulating the passage of materials to and from production centers, by means of a system of trucking and, perhaps, by a special force of move men

Shipping, crating, and packing, carting, and consigning to customers

In all of these operations it is necessary to keep materials at all times fully under documentary control, to facilitate supervision by higher officers with reference to quality, quantity, time value, place value, and money value.

PURCHASING

The chief distinctive administrative agency required in performing the above-mentioned functions is a separate purchasing department In most cases it will be found desirable to organize separately a stores department and a shipping department. The more complete classification of functions for administrative purposes tends, in large-scale operation, to result in.

1 Purchasing department
2 Testing department
3 Stores department
4 Planning room which, among its other functions, will have control of the balance-of-stores, and of move men
5 Cost accounting department which, along with other records of values fixed in the manufactured product, will handle the records of materials used
6 Shipping department in charge of receiving, packing, trucking, and shipping

Quality Control.—The naive beginning of efforts to reduce the labor costs of production has been to reduce wages and purchase a cheaper quality of labor. The futility of this soon became manifest to employers, who had systems of production control sufficiently developed to give them a general view of the facts This led to the formulation of the law known as the economy of high wages, so paradoxical to the uninitiated Likewise, the naive beginning of efforts toward economy in material cost has been the effort to buy cheaper materials, and drive sharper bargains with suppliers. A good knowledge of results will show that the weight of overhead expense and labor cost in manufacturing, and of good will in obtaining a market, is such that the first essential in material is the quality best suited for manufacturing and use, and that, in securing this quality, regularly and accurately, price is, within wide limits, negligible. This law deserves to be named the economy of quality materials.

A strict control of the quality of materials used in manufacturing serves to cut down the waste of raw materials, by reason of the rejection of imperfect units or portions, or the sacrifice of some unnecessary property. It facilitates uniform and high-speed manufacturing operations, by avoiding the necessity

for the readjustment of mechanism to fit changes of materials, the readapting of the processes of manual manipulation for the same reason, the using of more hand labor and less machine work because of the variety of operations entailed, the changing of tools, the stoppage of operations for inspection, the stoppage for instruction, the slow work of patching, improving, tinkering or partial remanufacture to eradicate defects, or the addition of extra finish to cover defects. It decreases the waste of material, labor, and overhead on account of spoiled work It is one factor in securing such quality in the resulting product as will secure the goodwill of customers, lessen sales resistance, and so lessen selling and advertising costs. It will be seen that an initial error in purchasing may entail a succession of expenses and difficulties at every step in the subsequent processes of manufacture, distribution, and consumption. An efficient process of purchasing is, therefore, something very much more than the mere matter of buying an article at the lowest market rate

"The selection of suitable raw material is a matter of the utmost importance," says G S Radford, "in which the governing considerations are uniformity, ability to meet service requirements, and ease of working in the manufacturing process First cost is a subordinate consideration in nearly every case, in comparison with uniform behavior in manufacturing and uniform performance under working loads A typical instance is furnished by the motor industry, where a very low-priced car has been built of the highest percentage of alloy steels There are better places for economy than in the raw materials "[1]

The Purchasing Officer.—The real work of a purchasing officer is to mediate between an outside market, ruled by commercial forces, and the shops of his company, ruled by technical considerations He aims to serve the shops promptly with the materials wanted, at minimum cost, and yet buy in commercial lots and insert the minimum of price-increasing specifications into his buying contracts He equates between a set of fluctuating price scales and a set of subtle quality scales To take the best advantage of prices he needs to be an expert in quotations, discounts, datings, freights, packing, the reputations of suppliers,

[1] The Control of Quality in Manufacturing, G. S. Radford, N Y Ronald Press, 1922, p 219

and the legal liabilities of the sale contract. To understand the quality scale he needs to know his company's products thoroughly, and know much of manufacturing processes and the physical properties of materials, and the meaning of scientific tests. He needs to have judgment to decide whether steady patronage of a few reliable suppliers or wide shopping of the market will bring the better results He must sometimes forego a price advantage for the protection of a supplier's better financial rating. He must at times increase his labors, with no saving, by so dividing patronage that a fire or a strike in a supplier's plant will not seriously cripple his company.

To create a purchasing department does not originate any new functions without which a concern was previously able to get along. Purchasing has to be done whether there is a purchasing officer or not a stock must be carried whether it is in a stock room or hidden away in the corners of the shops by the foremen; inspection has to be done either in advance, or with humiliation after an angry customer has returned defective goods. To organize a special department simply takes a group of responsibilities, which previously have been scattered around to annoy officers who are primarily interested in other things, and concentrates them upon a man who is specially fitted for the work, and who can gain expertness by continuous application to one thing.

The purchasing officer has come in with the architect who designs buildings, the engineer who specifies machinery, and the employment officer who selects men. As sales managers elaborate their plans and lay hold of psychology, they must be met in the customers' organizations by purchasing officers who are able to hold their own with technology.

The purchasing officer does not determine, on his independent initiative, what qualities shall be bought. He acts, in this, under the general direction of the department of engineering or design. Obviously the quality needed in manufacturing and in design is more of an engineering than a merchandising conception. The purchasing officer can contribute to its determination a knowledge of the commercial grading system, of the difference of prices between grades, and he can gather the opinions of the markets with reference to similar articles. Since he has a viewpoint dif-

ferent from that of design or production, his advice is valuable in determining problems of design and of the qualities of materials to use

Neither does the purchasing agent act with independent initiative as to how much to buy or when to buy He acts only upon requisitions issued by the production department, which keeps in touch with the schedules of the shops. It is well to define clearly the field of the purchasing officer. Some of the restrictions which may be desirable in particular cases are

1 Purchases to be made only on the requisition of the stores department, or of designated officers of the manufacturing and engineering departments.

2 Requisitions to be made only on the authorized forms supplied for the purpose, and to be signed by the proper officers

3 Purchases to be regulated in such a manner as to maintain the supply of each article within the maximum and minimum stock limits set for it.

4. Various limits may be placed upon the amount of individual purchases or upon the rate of purchasing, such as (*a*) purchases not to exceed three or six months' average consumption, (*b*) total purchases in any one month not to exceed —— dollars, (*c*) no single purchases to be made exceeding —— dollars, except with the approval of the general manager; (*d*) the purchase of designated articles or classes of articles, such as cars or locomotives in railway practice, to be reserved to higher officials. Such limitations avoid the creation of unusual current liabilities without the knowledge of the officers who will be responsible for making the necessary financial arrangements.

5 In the case of certain classes of articles the purchasing officer may be instructed to secure competitive bids, and to make purchases only of the lowest bidder. Or, for the sake of reciprocal business relations, he may be instructed to patronize certain firms, whenever possible.

Equipment.—Equipment may be inferred from functions First of all, the purchasing officer should be provided with information concerning supplying concerns

1. He should have a list of manufacturers and dealers supplying the articles regularly used, and of eligible bidders prepared to make any special products which may be required.

This information should include the location of the plant and sales offices, the names of the officers to be dealt with, freight rates, average time taken in shipment, whether orders can be filled from stock or are to be manufactured, time required to manufacture, maximum size of orders which can be handled, general reputation as to honesty, promptness, and technical competence

2. A file of catalogs of supplying houses should be collected. These may be arranged alphabetically according to firm name, with a cross-reference catalog according to article; or they may be classed according to articles, with a cross-reference catalog of firms.

3. A record of prices paid should be kept, including all quotations, discounts, and datings offered, with careful notation of the authority for the information.

The purchasing agent will need a number of records with reference to the shops of his own concern.

4 The amounts of leading materials consumed should be tabulated per month and year for some time past, to indicate how long a given lot will last Knowledge of any special requirements of the near future should be communicated to the purchasing officer in due time from the planning department, or whatever authorities have the advance schedule in charge.

5. A record of the experience of the manufacturing departments with previous stock should be kept, so that there shall be no reorder of defective materials. All defects reported, and all percentages of waste, should be tabluated against batches of materials, and against the supplying firms.

6 If tests have been made of samples of untried materials, the record of these tests should be supplied to the purchasing officer.

With reference to the transactions of his own office, the purchasing officer should know:

7 What the size of the usual previous order has been.

8. What prices have been paid previously

9. What delay in delivery, what shortage, or what departure from specifications has been experienced in dealing with certain concerns.

Requisitions.—Purchasing involves the making of an original requisition, the placing of the order, the following up of the order until delivery is secured, the checking-in of merchandise as com-

plete at the receiving office, the forwarding of the bill to the accounting department for payment, and the final payment

The machinery of the purchasing department is set in motion by a purchasing requisition The act of requisitioning materials bears a number of relations to the business of a plant, and the proper point for the origin of a requisition would seem to be the point where the most difficult problem connected with it must be settled.

Mr. D. S Kimball says "The demand for materials grows naturally out of the needs of the business and cannot, therefore, originate with the purchasing agent In a shop devoted to general repairs, the requisitions for materials would, most naturally, originate with the foremen in charge of work, since they will know better than any one else what is needed. In a shop building new work to order only, such as an engine works, these material requisitions for direct material would originate in the engineering department, though they might pass through the storekeeper's hands before going to the purchasing agent in order to check off material on hand In a shop manufacturing standardized articles, as knives, watches, etc , the material requisition would naturally originate in the stores department, which is the reservoir that feeds the factory, and here also would originate, always, the requisitions for all indirect and expense material In a shop doing all three of these classes of production, therefore, material requisition might originate from several sources, and just as it is necessary to centralize the authority and responsibility of the purchases based on these material requisitions, so it is absolutely necessary to fix definitely the authority and responsibility of originating these requisitions"[1] Under scientific management, all direct materials, the quantities of which are accounted for by jobs, are requisitioned by an officer of the planning department, who makes up the job requisition tickets from the routing sheets of proposed jobs, and keeps the balance of stores ledger.

Prices.—There is more to price than the establishment of the range of market quotations. Prices vary with the method of packaging required, with the terms of payment, with the delivery schedule demanded, with the size of the order, and depending

[1] Principles of Industrial Organization, Dexter S Kimball, N Y McGraw-Hill Book Co , 1913, p 202

upon whether the order stands alone, or is a delivery under a blanket contract which may cover the buyer's requirements for a period of time.

A method of avoiding the annoyance of closing a succession of price bargains has been developed by some railway systems. "In at least 20 per cent in number of the continuing agreements made on behalf of the Union Pacific and Southern Pacific Railway systems," says W. V. S Thorne, who was for many years in charge of the purchases of these systems, "it was found advisable to have the prices of the finished articles, when once agreed upon, thereafter automatically fluctuate in accordance with a fair sliding scale based on the price of raw material from which such articles were made, as quoted in the most reliable trade journal that is an authority on such matters, providing seller was not quoting lower prices to any other customer. The aggregate money value of the articles purchased under these sliding-scale agreements by the railway companies was about 60 per cent of the companies' total purchases which were made under continuing agreements

"These sliding scales applied particularly to certain manufactured products of iron, lead, hemp, rubber, linseed oil, etc., in which the cost of the raw materials amounts to from 50 per cent to 80 per cent of the cost of the finished article."[1]

The Order.—The order is a legal contract and should be drawn with care. Its major parts are, the names of the parties involved, the description of the goods, the statement of the price with all terms affecting it, and the specification of the time and place of delivery. Where large affairs are involved it is convenient to prepare a model contract, elaborate it until all essential conditions are covered and the language has been made exact, submit it to a competent attorney for revision, and adopt it as the standard to be used in all cases where special conditions do not preclude. The clauses of such a contract, depending upon the degree of elaboration desired, may be the following.

1. A definition of the merchandise desired.

2. The statement of allowable variations in quality, quantity, or dimensions.

[1] Quoted in Principles of Government Purchasing, A. G Thomas, N. Y, 1919. D. Appleton & Co, pp 255–270

3. Date (or date limits) of shipment or delivery Dates, or rates per week or month, of shipments or deliveries

4. An exact statement as to when title passes.

5. Price, with a statement of discounts and of the time and manner of payment

6 Rights of assignment or cancellation agreed upon Circumstances under which installments are to be treated as separate contracts.

7 Definition of any unusual or ambiguous terms and a waiver of rights due to misunderstanding of the terms of the contract. To illustrate, "immediate" shipment may be defined as within twenty-four hours of the receipt of the order, "prompt" as within three days, and "in a reasonable time" as within ten days.

8 An enumeration of the documents composing the contract. Drawings, specifications, statements made in letters and catalogs, etc, to which it is desired to refer, should be mentioned as a part of the contract and unmistakably identified It is better to embody them in the contract itself, above the signatures.

9. The description of any special method to be followed in settling disputes No provision aiming to deprive either party of its final appeal to the courts should be introduced, for such clauses involve the attempt to oust the courts from their jurisdiction, and hence are null and void

As need may indicate, other clauses can be introduced covering insurance, damage, inspection privileges during manufacture or on the seller's premises, obtaining permits, F O B. point, ownership of special tools, restrictions on use of designs furnished, etc

As an illustration of standard contracts, such as are drawn up by the National Association of Purchasing Agents, the Standard Pig Iron Contract is here reproduced.

STANDARD PIG IRON CONTRACT

NATIONAL ASSOCIATION OF PURCHASING AGENTS

Seller's No
Buyer's No

AGREEMENT entered into this day of 19 , between of hereinafter referred to as the Seller, and of hereinafter referred to as the Buyer

The Seller hereby agrees to sell and ship and the Buyer agrees to purchase and accept the quantity and kind of iron and at the price hereinafter stated upon the terms and conditions printed on reverse side

QUANTITY	ANALYSIS
GRADE	Silicon
BRAND	Sulphur
BRAND	Phosphorus
	Manganese

PRICE $ per ton of 2240 lbs. of molten or chilled metal and 2268 lbs for sand metal

TERMS
F O B. CARS AT
RATE OF SHIPMENT
TO BE CONSIGNED TO
DESTINATION
ROUTING
KIND OF CARS REQUIRED

TERMS AND CONDITIONS

1 TERMS OF PAYMENT

Non-compliance with said terms of payment shall give the Seller the right to suspend further shipments until all previous shipments are paid for, and if in the judgment of the Seller the financial responsibility of the Buyer shall at any time become impaired and written notice thereof be given by the Seller to the Buyer, the Seller shall have the right to suspend further shipments on this and all other contracts until adequate security for payment hereunder is furnished by the Buyer If such security is not furnished within thirty days from such notice, the Seller shall have the right to cancel this agreement Termination of the contract under any of these conditions shall not prejudice any claim for damages the Seller may be entitled to make

Unless otherwise written in this contract, point of delivery is f o b cars at destination, all freights are for the account of the Buyer including all revenue taxes which have now or may be hereafter imposed upon transportation facilities and service by Federal or State Government

2. WEIGHTS.

All settlements are to be governed by track scales at point of shipment excepting cases where Buyer's scales show a variation of more than 1% in the net weight In such cases, Seller shall immediately be notified by wire of discrepancy, having the option either of accepting certified weights furnished by the buyer as being correct or of demanding a check weight on tested track scales nearest to Buyer's plant, expense of check weight to be assumed by party found to be in error

3 CONTINGENCIES

Strikes, accidents, fires, floods, wars, interruption to transportation or car supply or to sources of supply of raw material, or other contingencies beyond the reasonable control of the Seller are to be sufficient excuse for any delay traceable to such causes Similar conditions affecting the works of the Buyer shall be sufficient excuse for any delay in accepting shipments, except shipments in transit at time of receipt of notice to stop shipments

(a) Each month's quota shall be considered as a separate and independent contract

(b) Seller's failure to ship during specified time any month's quota gives Buyer the privilege of canceling unshipped tonnage by giving ten (10) days' notice in writing In case of failure to accept by the Buyer, the Seller shall have the privilege of canceling upon same terms as above

4 ADJUSTMENTS

In case of dispute, sample shall be taken and analyzed by a disinterested chemist mutually agreed upon in accordance with the American Society of Testing Materials' Standard Method of Chemical Analysis of Pig and Cast Iron (serial designation A64–16) Result of test to be binding upon both parties and the expense to be borne by the party in error In the event that analysis of said samples shows a greater variation than allowable by A S T M specifications, the Buyer shall have the right to reject the shipment or shipments from which said samples were taken

5 COMPLETE AGREEMENT.

No understanding, agreements or trade customs not expressly stated herein shall be binding on the parties in the interpretation or fulfillment hereof unless such understanding, agreements, or trade customs are reduced to writing and signed by the respective parties

IN WITNESS WHEREOF the parties hereto have caused this agreement to be executed in duplicate by their respective officers duly authorized the day and year first above written

Seller Buyer

By By .

The Size of the Order.—Some of the attractions which move purchasing agents to place large orders are, the insurance which an ample stock gives that factory operations will not be suspended by railroad strikes or other interruptions of supply, the economy of large orders in the matter of freight, cartage, and receiving expenses, a favorable aspect of the market which seems to recommend the accumulation of a stock in anticipation of future requirements, and quantity prices. Toward small and frequent orders the inducements are, a smaller investment in stock, less opportunity for physical deterioration and for obsolescence of class

or design, decreased hazard of loading up at top prices or of entering dull seasons with heavy stocks, the possibility of securing quantity prices on the basis of annual patronage rather than of individual orders, and a more even distribution of bills payable.

The utmost advantage of buying on a large scale, consistent with light stocks and rapid turn-over, is only obtainable by standardizing consumption upon a few articles. An establishment without scientific purchasing is almost certain to show, in each class of stock, a variety of qualities, designs, and makes, representing the diverse opinions of different foremen and department heads, but intended to answer substantially the same purpose. The stream of stock change flows slowly through a wide variety of types, just as a river flows slowly through a multitude of bayous it is possible to place small orders, and yet have a store room choked with stock To attain the opposite condition of heavy orders and a light stock, there must be concentration of demand upon a few things. The process of throwing out unnecessary variant types of stores must rest upon a thorough examination of shop requirements It is likely to involve some remodeling of operations, possibly also some redesigning of finished products. When the best has at length been chosen, usage must be standardized

Specifications.—Increasingly, as science makes progress, the one intelligent way to buy is upon the basis of a carefully drawn specification. Specifications may originate with either the seller or the buyer. The usual custom of the past has been for the seller to specify what he had the growing practice of the present is for the buyer to set forth in detail what he wants.

Seller's Specifications.—Seller's specifications are the descriptions found in catalogs and letters and advertisements, and in the communications of authorized agents. The law considers these to be a part of the contract of sale as express warranties, provided they have exerted a material influence as inducements with the buyer. It is particularly to be noticed, however, that no affirmation of mere opinion on the part of the seller, such as that he believes the goods will wear well, or that he expects their price to increase, constitutes a warranty. Some allowance is also made by the courts for mere puffery, or dealer's talk, such as that the goods are the best in the world, or that they are worth ten times the price If a sample is offered by the

seller under conditions which imply that it is intended to be representative, it partakes of the nature of a description, and creates the implied warranty that all of the goods furnished will conform to the sample. If the seller is a manufacturer, and so presumably possessed of an intimate knowledge of the sample offered, there is a further implied warranty that the goods furnished shall be merchantable, that is to say, passable as representative of the kind of merchandise which passes current under the given designation; and that they are free from such defects as are not discoverable by a reasonable examination of the sample. If, however, the buyer has ample opportunity and talent to discover the defects of the sample, and there is no fraud involved in the transaction, the rule of *caveat emptor* applies.

Buyers' Specifications.—To avoid the uncertainties of interpretation and of legal liability involved in seller's samples and trade descriptions and advertising, the practice is growing among large concerns of buying materials and supplies on the basis of specifications prepared by themselves. These are drawn up by the purchasing department, working in conjunction with the testing laboratories and the shops. Furthermore, as the maker of an article has a body of knowledge as important as that possessed by the user, a specification should be the joint product of the two. When such a specification becomes a part of a purchase contract, the supplier is bound by an implied warranty that the goods supplied will be of the kind described and will pass the tests prescribed.

To secure a concrete idea of a specification let us consider an example. It is the United States Government Specification for Portland Cement, the result of several years' work of experts representing the United States Government, the American Society for Testing Materials, and the American Society of Civil Engineers. This specification is to be found in Circular 33 of the Bureau of Standards. In this pamphlet about $1\frac{1}{4}$ pages are required for the specification, and 22 pages are devoted to explaining the tests. The specification portion, only, is as follows:

UNITED STATES GOVERNMENT SPECIFICATION FOR PORTLAND CEMENT

Definition

1. Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate and properly proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum

Chemical Properties

Chemical Limits

2. The following limits shall not be exceeded

	Per Cent
Loss on ignition	4 00
Insoluble residue	0 85
Sulphuric anhydride (SO_3).	2 00
Magnesia (MgO) . .	5 00

Physical Properties

Specific Gravity

3 The specific gravity of cement shall be not less than 3.10 (3 07 for white Portland cement). Should the test of cement as received fall below this requirement a second test may be made upon an ignited sample. The specific-gravity test will not be made unless specifically ordered.

Fineness

4 The residue on a standard No. 200 sieve shall not exceed 20 per cent by weight

Soundness

5. A pat of neat cement shall remain firm and hard, and show no signs of distortion, cracking, checking, or disintegration in the steam test for soundness

Time of Setting

6 The cement shall not develop initial set in less than 45 minutes when the Vicat needle is used or 60 minutes when the Gillmore needle is used. Final set shall be attained within 10 hours

Tensile Strength

7 The average tensile strength in pounds per square inch of not less than three standard mortar briquettes composed of one part cement and three parts standard sand, by weight, shall be equal to or higher than the following

Age at Test Days	Storage of Briquettes	Tensile Strength Pounds per Square Inch
7	1 day in moist air, 6 days in water	200
28	1 day in moist air, 27 days in water	300

8 The average tensile strength of standard mortar at 28 days shall be higher than the strength at 7 days

9 The cement may be rejected if it fails to meet any of the requirements of these specifications

10 Cement shall not be rejected on account of failure to meet the fineness requirement if upon retest after drying at 100° C for one hour it meets this requirement

11 Cement failing to meet the test for soundness in steam may be accepted if it passes a retest using a new sample at any time within 28 days thereafter.

Of the influence of this specification Secretary Herbert Hoover has said "I need only point to the case of cement, where practically the whole output of the country is now produced and distributed on the basis of Federal standards and tests—it being sufficient in the purchase of cement simply to state 'Federal specifications.' It has been a great boon to the cement industry to establish the uniformity and quality of its products; it has been an even greater boon to the construction industries of the country to share in the benefits of such establishment of quality and such method of test." [1]

A practical set of specifications should contain a concise and unequivocal statement of the physical properties required in the article, and of the method of sampling and testing which will be followed in making determinations. No material should be specified as a constituent, which it is impossible to identify in the finished article. Nothing unreasonable, considering the state of the arts, should be required, for proof of unreasonableness operates

[1] Address before Conference of State Purchasing Agents, Washington, D C May 26, 1923. Published in Scientific Management Since Taylor, E E Hunt, Editor, N. Y. McGraw-Hill Book Co , 1924, pp 189–196.

as a legal defense for non-performance. There should be the fewest number of restrictions which will do the work, as every restriction raises the price. For the same reason no restriction should be left in the specification which it is not intended to enforce strictly. No quality needs to be specified which is implied by another quality or is necessary to pass a test. Specifications are business documents and should not be too complicated, otherwise they will fall into disuse. The qualities and tests should be explained in the simplest manner. In every case a simple test, which will answer the purpose, should be preferred to a more complicated one.

Modern scientific specifications cannot be used. (*a*) where materials are wanted which pass through the hands of a produce exchange, such as the New York Cotton Exchange or the Chicago Board of Trade, on which grading is done exclusively according to the rules of the organization; (*b*) where unfabricated materials, such as wild rubber gathered by the natives of the Amazon valley, originate with a large number of small producers who are not under control, (*c*) where materials come from a distance, passing through the hands of many intermediary traders, as is the case with European manufactures generally, so that the buyer's requirements cannot be referred back from hand to hand to the sources of supply; (*d*) where materials are controlled by a monopoly or are produced by a secret process.

Testing.—The main support of a purchasing agent, in buying on a scientific basis, is a department of tests, with a properly equipped laboratory. Without such a department the purchasing officer must limit his purchases to firms whose absolute dependability as to quality has been proved by shop experience. Such a laboratory can prepare the technical portion of specifications, analyze the samples submitted by suppliers, and test the merchandise purchased by the company, either before it is consigned or after it is received, to ascertain whether or not it conforms to the specifications. Mr. G S Radford has said, "To be in a position to call for better materials, the manufacturer must first know what qualities he requires and why. Also, once the required standards are set, means must be provided for measuring the incoming deliveries, for it is useless to set standards unless one is prepared to enforce them. The factory should be protected by

filtering out unsuitable material at the receiving platform of the stockroom. . . . The control of quality begins at this point, in so far as the individual factory is concerned." [1]

All tests involve a certain amount of variation. The allowance for this may be handled in two ways. The limits may be made wide enough in the specification to allow for them. The supplier must then understand that all material must be safely within them after allowance has been made for the unavoidable variations in tests. Or else the limits may be set narrower in the specification, but the buyer may fix his private rejection limits enough wider to allow for variations in tests.

With reference to the disposition of material which is shown by the tests to be defective, there is only one intelligent policy. The specifications should be strictly adhered to or else the specifications should be withdrawn All material tendered should be within the specifications: that is to say, complete lots should be judged by the result of a test on a fair sample On this point the highest practice was thus stated by Mr. Charles B. Dudley, in his presidential address before the American Society for Testing Materials in 1907, on the basis of the experience of the Pennsylvania Railroad Company:

"Let us assume that the specification has been wisely drawn, that a shipment has been properly sampled, and that the tests show that it does not fill the requirements. What is the next step? As a matter of fact in our own daily work, but one thing is ever done, and that is the material is rejected None of our specifications provide for a second or third sampling and corresponding tests. Our theory is that the material ought all to be of the grade called for by the specifications, since this is what the consumer has bargained for, and if this is the actual fact one sample is as good as fifty. We are quite well aware that there are many specifications in force which provide for second, and, if need be, third tests, the fate of the shipment to be decided by the majority. But this has for a long time seemed to us to be a survival of the crude early days of testing, when neither producer nor consumer knew much about materials, and which it is high time should be banished forever. If a specification is so severe that only two-

[1] The Control of Quality in Manufacturing, G. S Radford, N. Y. Ronald Press, 1922, p 274.

thirds of well-made material will stand test, the specification should be changed; and if a manufacturer can only make a product, two-thirds of which will stand test, he should either learn how to improve his product or go out of business." [1]

Rejected material should be taken only at a proper price concession. Otherwise, unsuccessful bidders, who intended to fulfill the specifications, are unfairly dealt with, and a bad precedent is established in the direction of undermining the specifications. Retests should be made only when there is good ground for suspecting the accuracy of the tests already made.

Hedging.—To return to the commercial side of the purchasing officer's work, that officer is bound to take notice of the financial risk which his company runs when it buys and holds materials without having at hand sales contracts to cover the resulting product, or when it contracts to make future deliveries of its product without owning the materials which will be required. So fluctuating are commodity prices, especially since the World War, that changes in the prices of basic materials may take place during the process of manufacturing which will entirely destroy the manufacturing profit. The possibility of loss or gain may be illustrated by tabulating the range of prices of a few commodities

Lowest and highest average monthly price of lake copper in cents per pound in New York City·

Lowest	Year	Highest	Lowest	Year	Highest
14 86 Mar	—1919—	22 32 Aug	12 61 Apr	—1922—	14 00 Dec
13 19 Dec	—1920—	18 92 Jan	12 58 Oct	—1923—	16 84 Mar
11 63 Aug	—1921—	13 56 Dec	12 35 June	—1924—	14 09 Dec

Highest and lowest spot price for middling upland cotton in New York City, in cents per pound

Lowest	Year	Highest
28 85	—1919—1920—	43 75
10 85	—1920—1921—	40 00
12 80	—1921—1922—	23 75
20 35	—1922—1923—	31 30
25 30	—1923—1924—	37 65

[1] The Enforcement of Specifications, Chas B Dudley Proc of Am Society for Testing Materials, Philadelphia, 1907, pp 19–38

Highest and lowest monthly average price of Bessemer pig iron per gross ton at Pittsburg

Lowest	Year	Highest
$29 35 Apr	—1919—	$37 00 Dec
36 96 Dec	—1920—	50 46 Sept
21 96 Aug	—1921—	33 96 Jan
21 46 Feb	—1922—	35 27 Sept
24 64 Dec	—1923—	32 77 Apr
21 76 Aug	—1924—	25 26 Feb

An experienced mill buyer of cotton has said: "As a general rule, it is more disastrous to buy at too high a price than to fail to buy at a low price, because if cotton advances, in normal conditions of the market, goods will advance in proportion, but if cotton declines after you have bought, the market for goods is apt to decline also, leaving you to take a loss on your high-priced cotton " [1] This is equivalent to saying that it is worse to make an actual loss than to miss a possible profit

If, in the case of a fluctuating commodity, there is an organized market for future trading, the buyer may eliminate the greater part of his risk, and insure to his concern the normal profits of converting, by means of hedging transactions. The hedging operation will take one of two forms, according as it is to offset a long interest (the interest created by owning a commodity) or a short interest (the interest created by engaging to deliver a commodity, or its manufactured derivatives, without owning it) If a mill possesses a stock of raw material and has not contracted for the sale of the corresponding product, the appropriate hedging transaction will be to sell on the Exchange an equal amount of that material for delivery at approximately the date or dates when the stock or its product will be sold If then, in the interval while thus protected, the price of the material falls there will be a loss on the stock held, but an equivalent gain on the future transaction, because the material required to fill it can be purchased at correspondingly less than the price which the contract calls for. If the price rises, the gain on stock will be offset by an equal loss on the future transaction

[1] The Business Side of Cotton Manufacturing, J R MacCall Trans of New England Cotton Mfrs Assn, Boston, No 77, Sept 1904, pp 142–151 (Now Nat'l Assn of Cotton Mfrs)

In case a mill contracts for the sale of its output in advance of the purchase of the necessary raw materials, the proper hedging transaction is to enter into future contracts upon the Exchange to receive the respective amount of basic material, at the period when it is expected to buy the actual supplies for manufacture. Future contracts are usually closed without actual receipt or delivery of commodities; and this is done by selling them just prior to maturity to brokers for ring settlement or mutual cancellation.

While dealings in futures offer considerable relief, they do not provide a perfect means of extinguishing risk, for the advances and declines of futures do not exactly correspond to the advances and declines of the spot prices of the same materials; still less perfectly do they correspond to the fluctuations of the manufactured derivatives of those materials.

Honesty.—Honesty must be a militant virtue with the purchasing officer. This is so because he has in his hands a patronage for which outsiders are in active competition, and because the results of private advantage can only be made apparent by cost accounting, a branch of accounting which is much less conclusive in its results than that employed for keeping track of cash. To delegate to another the power of purchasing supplies is to furnish money—the measurement of which is exact enough—but to hold for quality in commodities, the measurement of which has as yet been made exact only in the case of a few materials. The problem of answerability in that form of delegated authority where the quality scale covers the value scale from direct access is an ancient one. Kipling says,

> " Who shall doubt the secret hid
> Under Cheop's pyramid
> Is that the contractor did
> Cheops out of several millions;
> Or that Joseph's sudden rise
> To Controller of Supplies
> Was a fraud of monstrous size
> On King Pharaoh's swart civilians."

The risk entitles the purchasing officer to every moral safeguard his employer can throw around him To leave him with-

out the checks of an efficient system of supervision is not so much to trust him as to abandon him in a moral contest.

The Stores Department

In establishments where any considerable variety of materials is used, if a stores or stock department is not provided, there will exist a confused and expensive and inadequate condition of individual self-help. The foremen, ignorant of the exact amounts of material required for jobs, order excess quantities, to be on the safe side. Every foreman or department head who remembers previous delays, or who looks ahead to protect his men from layoff in a dull time, will try to accumulate a secret reserve, and run a little warehouse of his own in some corner. Such a system of private stores will involve much duplication, for the sum of the reserves of any one material in a series of separate lots will be more than would be needed if the lots were pooled. The individual requirements are not permitted to average themselves out in a more uniform and predictable rate of aggregate use.

In spite of excess material, an unsystematic condition will involve much delay in waiting for required things, for no comprehensive agency exists to see that the assortment is complete. A need in one department is not met by an unknown supply in another. Energetic department heads will prefer to order new material rather than hunt outside of their department, or will take materials too good for the job in the absence of the things which economy would dictate.

If inadequate handling of raw stores causes unbalanced supplies and the expenditure of labor without corresponding product; the inadequate control of finished stocks leads in like manner to the production of goods not needed. The foreman who secretes a reserve of stores to protect his men from layoff turns out finished products without authorization, and throws the stock out of balance. The absence of a stores system hides spoiled work, for the workman can get a new piece of material to take the place of the spoiled one without creating a record.

A stores system, for a manufacturing establishment, is such an orderly administration of the values locked up in materials during the making process, as the stock system of a wholesale or retail store is for corresponding values during the distributive

process. The system which comprises requisitions, shop orders, store room, and a continuous invoice, is for materials an analogy with the system composed of the bill, the receipt, the safe, and the cash account used for handling money.

It has been said that "stock is more important than the money it represents." It represents not only the purchase price, but the cost of selecting, buying, inspecting, and shipping. If properly selected, it is worth more than this sum because it is not a mere sum of value but a form of insurance to guarantee the regular operation of the shops and the prompt filling of customer's orders.

Functions.—The functions of a stores department may be reduced to four.

1 The receiving, storing, and safeguarding of materials

2 The service of issuing stores as desired by the manufacturing and shipping departments

3 The maintenance of records which will show at all times what is on hand or expected, and what has been issued or reserved, classified according to items and order numbers

4 The giving of timely notice when replenishment is required, by establishing minimum quantities for each item, and issuing purchasing requisitions, if replenishment is by purchase, or shop requisitions, if replenishment is by manufacture.

Stowage.—A store room should be systematically laid out and equipped with separate receptables especially suited to facilitate access, identification, and storage for each item of stock The location of any item will depend upon its size, weight, shape, quality, perishability or delicacy, quantity carried, and frequency of use Accessibility is insured by stowing as far as possible in issuable units, each lot or item distinct, and the greatest number of units showing Identification is facilitated by marking the articles, or by tags or packages, and by identifying names and numbers on each bin or stowage space In the case of some articles difficult to identify, samples may be mounted on the ends of the appropriate cases, with names and bin numbers Rotation in stock is facilitated by putting in and taking out on a plan: it is insured by the double bin system This consists of the provision of two adjacent stowage spaces for each class of stock, each large enough to hold a lot Requisitions are always

filled from one bin until it is empty, then from the other, and so on alternately. New stock is always placed in the reserved bin

Stores and stock may be located in a single central space, or raw materials may be located next to the initial stage of manufacture, while finished stock is carried next to the shipping department In a Unit U factory plan, this might bring both divisions side by side The location of sub-stores is a question of trucking economies, and of control

Stock records.—The purpose of stock records is

(*a*) to show the quantities of stock on hand of each sort, and enforce responsibility for their safeguarding, by crediting all receipts to the proper purchasing orders or manufacturing orders, and charging all items issued against the proper manufacturing order or shipping order,

(*b*) to preserve intact the function of the stock department as an elastic member between the manufacturing shops and suppliers of raw materials, by giving notice to the purchasing department through purchasing requisitions whenever a purchased item reaches a given minimum, so that purchased stock will always be adequate,

(*c*) in case of establishments which manufacture for stock, to facilitate the function of the stock department as an elastic member between the manufacturing shops and customer's orders for products, by giving notice to the manufacturing department through a manufacturing requisition, whenever a manufactured item reaches minimum point, so that the manufactured stock will always be adequate

It is not sufficient to deal simply with the actual quantities on hand. The probable future fluctuations of demand and supply, as they influence each item of stock, can be followed only by considering the supply on hand as soon to be increased by additions from purchases which have been authorized, and as soon to be decreased by withdrawals to take care of manufacturing orders or shipping orders authorized.

The controlling stores account, sometimes called the balance-of-stores account, is a series of ledger pages, one page for each item of stock. Each page shows the name of the item, with brief description, and symbol, and gives the minimum stock limit, the amount to be ordered whenever this minimum is reached,

the location in stores, and the posting rules. Below this heading are four accounts set side by side. On account of the size of the page of this book we must here arrange these accounts one above the other. They are as follows.

1—STORES ORDERED BUT NOT YET RECEIVED

Date of Req.	Requisition No.	Purchase Order No	Quantity	Quantity on Total Orders	Date Received

2—STORES ON HAND IN STORE ROOM

Date Received	Quantity	Date Issued	Issued for Order Number	Total Cost	Cost per Unit

3—STORES APPORTIONED TO ORDERS BUT NOT YET ISSUED

Date Apportioned	Quantity	Order Number	Date Issued

4—STORES AVAILABLE, THAT IS, ON PURCHASE ORDERS AND ON HAND

Date	Quantity		Remarks

The instructions for posting are:

A When stores are ordered, add the quantity to accounts 1 and 4
B When stores arrive, subtract the quantity received from account 1 and add the quantity received to account 2
C When stores are apportioned, subtract quantity from account 4, and add quantity apportioned to account 3
D When stores are issued, subtract quantity from accounts 2 and 3

Note In all cases bring down at once balance on hand in each account affected

The accuracy of the balance of stores on hand will be tested from time to time by an actual invoice

Elasticity, or allowance for change of program, is required at some point in every chain of functions If the manufacturing departments are, at one time, being held up for lack of supplies, and at another time are thrown into confusion by a rush order, which side-tracks the regular work, it is obvious that these departments are being used as the elastic member to take up the slack and tension between the incoming stores and the outgoing stocks This is a costly error. The very idea of a stock or store is a reserve for contingencies The schedule of manufacturing operations should be protected from the shock of the irregularities of external business relations by adequate buffers of stock at the entrance and exit ends At the raw-material end, stores serve to even out the irregularities of supplier's deliveries, at the finished-product end, stocks meet the fluctuations of consumers' demand Protected by these two reserves, the schedule

of manufacturing operations is permitted to attain the efficiency of continuous operation and mass production.

Problems

The Layout of a Stockroom.—A small manufacturing establishment has a stockroom laid out as is indicated in the diagram given There are two end walls with doorways leading to other departments There is one outside wall with five windows the partition wall opposite to it is without windows Shelving has been built against the walls, where

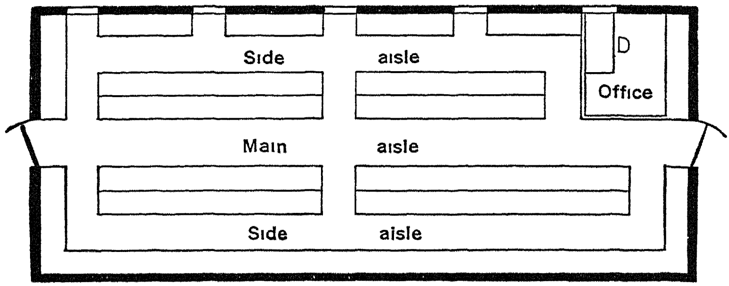

Fig 35—The Layout of a Stockroom.

possible, and in addition four long banks of double shelving have been placed so that they stand free with aisles on all sides The main aisle is 4 ft wide the other aisles are 3 ft wide A small office has been fitted up in one corner On the shelves within the office some of the more valuable supplies are kept How would you rearrange the layout so as better to occupy this space? How would you lay out a stockroom, with storage space equal to that shown in your revised plan, if you could adjust walls and windows and doors to suit the aisle and shelving plan?

Building up a Stores System.—If you were placed in control of the stores department in a plant where everything having to do with unworked stores and finished stock is in a state of confusion, what sort of system would you inaugurate? Point out, step by step, what you would do in the way of establishing a system of accounting for material, and in equipping a stockroom Indicate, also, what set of rules you would draw up for the control of all matters pertaining to material

The Problem of Purchasing.—Someone has said that most of the problems of purchasing can be solved either by tying up to a reliable supply house, or by sending out notices of requirements, and accepting the lowest bids What is to be said in reply to this? Formulate briefly the major requirements of a good purchasing system

Reciprocity in Buying.—Upon opening bids for a supply of coal, a corporation discovers that the lowest bidder is a corporation which has

never been a customer, while the next to the lowest bid—and there is only a small difference between the two bids—is from a company which regularly purchases machinery from it. Shall the corporation favor the firm which is its patron, and practice reciprocity in buying, or shall it award the contract strictly to the lowest bidder? It was the expectation of the bidders that the lowest bid would secure the contract, although, of course, the corporation was careful to reserve to itself the right to reject any or all bids. It might be possible to induce the customer-bidder to bring its bid down to that of the lowest bidder, if it were given the opportunity. If this should take place the corporation would have the advantage of the lowest terms discovered through the competitive bids, and it still would make the customer company feel that it had been favored. If it were known among suppliers, generally, that reciprocity in business controlled the corporation in its purchasing, it is probable that a number of them, who have not been patrons, would decline to bid in the future.

Barometers to Control Purchasing.—Lay out horizontally, upon cross-section paper, a good-sized time scale covering the months from the beginning of 1919 to date. Allow space vertically for a variety of quantity scales. Upon this base plot with record lines (so adjusting the quantity scales that the lines will lie as far as possible in the same plane and will interlace) a number of business barometers, for which data can be secured. The following are mentioned by way of suggestion: unfilled tonnage of the United States Steel Corporation, the index of wholesale prices of Dun or Bradstreet or the Bureau of Labor Statistics, any general business barometer procurable from the files of the Bulletin of the Federal Reserve Bank, barometer B or E. E. Day's Volume of Manufactures from the Harvard Economic Service, a stock market average such as is found in the *N. Y. Times*, the *Wall Street Journal*, or the *Commercial and Financial Chronicle*, and some typical record of interest rates. Against the background provided by these records, or any of them, plotted preferably in red ink, draw in with black ink a record line of the price fluctuations of some standard quotation of a raw material used widely in manufacturing, such as pig iron, middling upland cotton, raw packer's hides, sole leather, lumber, copper, rubber, etc. Indicate to what degree any barometer, or any combination of barometers, possesses predicting power which would be of use to a purchasing officer in determining his schedule of purchases. Assume that the purchasing officer will not buy more than a six months' supply, unless he feels confident that he can make a profit of approximately 15 per cent on the excess investment involved.

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CHAPTER XV

COST ACCOUNTING

If we picture to ourselves a typical manufacturing plant and attempt to classify the various expenditures which are involved in holding it in a condition ready for production, and in actually carrying on productive activities within it, we shall not be long in observing that these expenditures divide themselves into three main groups. The first of them includes the materials of which the product is composed, the second comprises the labor directly applied to these materials. The third group is composed of all those remaining items of outlay which do not attach themselves in a direct and definite way to the production of any individual unit of output. The first and second classes of expenditure are easily computed; when combined they form what is called prime cost. The third group is known as factory burden, or overhead, or simply as "expense."

In a machine-building establishment, these three elements of costs are approximately equal in amount. And if to them we add interest on the capital invested—an item which is, properly speaking, a profit, but which for certain purposes it is convenient to handle as a cost—we should have four approximately equal subdivisions of outlay.[1] In cotton spinning the cost of direct materials is nearly twice the direct labor cost: factory burden nearly equals direct labor: interest charge is a little more than one-half the direct labor cost. In the boot and shoe industry direct materials will average somewhat over two and one-half times direct labor, while factory burden will average a little less than seven-eighths of direct labor, and interest will be not much over one-sixth of direct labor cost. In petroleum refining a typical cost calculated by the Bureau of Corporations

[1] Human Factor in Works Management, James Hartness, N. Y. McGraw-Hill, 1912, pp 155–156.

showed direct material four times direct labor, and factory burden less than one-half of direct labor. A fair interest charge would be over one-third of direct labor cost. The effect of the invention of more perfect machinery, and the devising of more perfect systems of management is in the direction of increasing the amount of overhead, relative to the other factors.

The general relations of different classes of costs to each other may be illustrated by a diagram which separates the component parts of selling price.

SELLING PRICE

COST

MANUFACTURING COST

SHOP COST

PRIME COST

DIRECT LABOR	MATERIAL	FACTORY EXPENSE	GENERAL EXPENSE		SELLING EXPENSE	PROFIT
			ASSIGNED TO FACTORY	ASSIGNED TO SELLING		

FIG 36 —ANALYSIS OF SELLING PRICE

Direct Material Cost.—The most tangible and specific beginning of cost is when raw materials are purchased, out of which a finished product is to be made. When materials are used exclusively for a particular job—a job being a series of productive steps ending in the completion of a unit or lot of product—and when it is easy to measure the amount of the material used in connection with each job, the cost of such materials may be charged directly as direct material cost. The original cost may be interpreted either as the actual purchase price, or the last price, or the average price. Into the laid-down cost there enter other items, such as freight, cartage, and the expenses of receiving, storing and issuing. These items will be difficult to subdivide

onto each batch of materials requisitioned for a job, and so will be most practically handled as a part of factory expense.

When we turn to such materials as coal, machine oil, belting, polishing substances, and the like, we find that if we attempt to calculate the amounts used on individual jobs and fix the costs of such amounts, we shall be engaged in a hair-splitting operation The practical course is, therefore, to throw these sums into expense. As Mr. H A. Evans says, " Like direct labor there is some material that enters into the product that cannot be charged as direct material, but must be charged indirectly glue used in a joiner shop or pattern shop, a few nails or screws used on a repair job, a small amount of solder on sheet-metal work; a few cotter pins on a job in the machine shop; the red lead or litharge used in making joints; the material used with the oxy-acetylene welding plant, and many other similar items On account of the difficulty of measuring the quantity used of some of this material and the small amounts used of other classes, it is impracticable to charge these direct, and they must be included in the indirect charges."[1]

Direct Labor Cost.—Turning to the labor used to make a salable product, we find no difficulty in charging directly the wages of those persons who deal immediately and exclusively with the work of a single job, and are engaged for a considerable interval of time upon each job. The expenses of the men at the benches, or in control of the machines, or at work on the erecting floor, can be disposed of easily by means of time cards stamped with the starting and stopping time of the workman on each job The time of the labor day will be determined by registry in and out. But the sum of the job cards, plus any time counted out by the foreman (as on account of breakdowns) will equal the time for the day. But when we consider the expense of truckers and crane handlers and foundry helpers, who pass rapidly from job to job, spending perhaps a few minutes on each task, we perceive that it would be impractical to dissect the time of such men into minute fragments for charging purposes, and so these items pass over into factory expense

Expense Items.—We now come to the category of "expense,"

[1] Cost Keeping and Scientific Management, H A Evans, N Y, 1911 McGraw-Hill, p 27

of which something has already been said This may be divided into factory expense, selling expense, and general expense. Factory or manufacturing expense will include the items which have been previously mentioned as excluded from direct material and direct labor. Because of a somewhat different trouble in allocation, arising from the fact that they serve many different jobs concurrently, the wages and office expenses of the foremen, and the works manager, together with the expenses of all service departments outside of the shops, which minister exclusively to the needs of the manufacturing process, such as the planning room and the tool room, must be carried to factory expense Here will be placed charges for occupancy for real estate and buildings, and stand-by charges for equipment used in manufacturing. The five normal elements of occupancy and stand-by charges are interest on the investment, repairs, depreciation, insurance, and taxation

An entirely distinct collection of expense items is incurred in maintaining the selling and advertising activities, together with their attached services for shipping, credit, and collection. A third group of expense items has to be provided for on account of the general management of the business, including the salaries and office expenses of the general officers, together with the expenses of the accounting, legal, employment, and other general services These cannot be charged wholly to factory or selling expense, because they perform functions essential to both manufacturing and selling.

Expense Items as Functions.—Some of the items of expense are pure functions of time, like taxes, rent, insurance, obsolescence, and a portion of depreciation. These outlays are incurred as a result of the mere existence of a business, regardless of whether the production of a period is large or small, or indeed whether the establishment be running or closed down. Other expense items, such as those for power, supplies, and salaries, will rise and fall with the activity of the business, though not in strict proportion to it. Still others are quite strictly functions of the rate of production.

The Grouping of Cost Items.—The grouping of cost items may be made with one of two objects in mind, to fix a price on a product, or to lower the cost of the product by improving efficiency.

If the object is price, there will be spread upon the direct costs, the various items of expense in such a way as to arrive at a conception of total cost, upon which prices may be based and sales made, to accomplish the repayment of the expenditure. If the object is to isolate some unit, such as a machine, a process, a shop, or an executive officer, for scrutiny, no item should be added to the account which will dilute the measure, and cover up the significant relationships The traditional groupings of cost accounts have all had the first object in view, namely, to ascertain costs so that prices might be based upon them. The second principle of grouping represents the new aim of using cost accounts as an instrument of efficiency in production.

The Grouping of Costs to Determine Prices

Systems of Spreading Expense.—Let us consider the problem of spreading expense, with the object of fixing total costs and determining prices. The items of cost for direct material and direct labor are somewhat difficult to collect, because accuracy of reporting is required of a large number of persons, but once collected they may be distributed with ease upon the proper jobs. The items of expense, on the other hand, are easy to collect, but their distribution involves questions of theory so complicated, that, for the most part, they must be solved by arbitrary methods. If a business is of a very uniform nature, like a water-works, or a gas-works, or a blast furnace, or a brick yard, or a mill for the manufacture of flour or cement or paper, the various items of cost will tend to rise and fall together. Under such conditions it will not matter greatly what method of spreading is used, for any method will be, in reality, but a division of costs into those which pertain to different periods of time rather than a distribution of them But when the different items of cost follow different laws of variation, the manner in which they are grouped and prorated with reference to each other becomes important. The object will then be to discover items which tend to rise and fall in response to the same law of variation, and combine them on the basis of this common characteristic, so that the law of variation, whatever it is, may be used as the principle of spreading.

Percentage on Materials.—An infrequently used method of distributing expense, and one which has little to recommend

it, except its simplicity, is to divide expense as a percentage added to the cost of direct materials. Inasmuch as the cost of materials changes frequently, this method gives fluctuating ratios and unstable total costs. Expense is likely to increase less rapidly than output, it is likely to vary inversely with the quality of materials used; but it remains almost entirely uninfluenced by changes in the price of materials.

Percentage on Labor Time.—If direct labor time is classified according to the jobs upon which it is expended, it will be possible to distribute expense as a rate per man hour. Such a system of spreading exerts a pressure upon the management to save the time of the force. In this respect policy follows fact, in so far as expense is a function of time; but overemphasis of time endangers quality of output, increases wear and tear on equipment, and endangers the health of employees. Furthermore, such a system of spreading leaves out of account the difference in the cost of equipment provided for different workmen. If an operative at a bench, working with a kit of tools worth $25, spent an hour on a job he would draw down as large a proportion of expense upon his job as would a machinist who used a $2500 planer for the same length of time. To ignore the cost of special equipment in assessing individual jobs may, perhaps, incline foremen who are competing for low-cost records to outrun each other in recommending the purchase of new machinery to save labor time, but it fails to bring out the expense of allowing equipment to stand idle or be operated at a speed below its capacity.

Percentage on Labor Cost.—To tabulate expense as a percentage on direct wages is a simple plan, and one very generally used. As it emphasizes wages it appears to recommend the policy of employing cheap men, a policy which becomes fallacious when incompetent men are selected, since such men increase factory expense rather than diminish it This system, like the preceding one, fails to distinguish between jobs which use expensive machinery and those which employ little equipment.

Percentage on Prime Cost.—The use of this plan depends upon no principle of superiority in theory, but entirely upon the practical circumstance that prime cost is a perfectly clear concept, and that the figure representing it is usually at hand. A mere favorable ratio of burden to prime cost is of no significance.

for an increased burden may, as in the case of scientific management, be associated with decreased prime costs and decreased total costs per unit of product.

Machine Rates.—A machine rate is composed of items withdrawn from expense, and representing the more important parts of the cost of operating a given machine or other large unit of productive equipment It is spread as an hourly charge upon all work using such equipment. A machine rate may be used when any of the previously mentioned systems are used to distribute the remaining items of expense; its effect will be to amend their neglect of equipment. As ordinarily composed, a machine rate includes the five normal elements of stand-by charge, plus whatever service charge may be added to cover the cost of power, supplies, etc. The machines are not rated separately, but are grouped into classes, each class having an expense rate

As these hourly rates are based upon the assumption of continuous use, if a machine lies idle, an idle-time charge accumulates, which must either be spread as a supplementary machine rate upon the jobs using the machine, or be thrown into general expense and spread over all jobs. When machines are operated overtime there is created a supplementary rate which must be deducted from the full-time rate.

The Penalized Job.—After the various classes of machines in an establishment have been given an hourly rating, if a job is transferred from the proper machines, because they are all occupied, to an idle machine of higher rating, it does not seem fair to penalize the job by the amount of the difference in the rating. No greater offense has been committed than to use equipment which would otherwise have been idle The proper relief is either to carry the extra charge to the jobs normal for the machine used, or else to throw the item into general expense

Production Centers.—The idea of a machine rate has been expanded and perfected by including more and more items of expense in it, and by dividing the machines of an establishment into a larger number of classes, so that each machine may carry an hourly rate which is approximately correct. The culmination of this tendency is the proposal to divide the entire working space of an establishment, including the locations of machines and work benches and erecting floors, into a series of produc-

tion centers. For each of these centers an hourly rate or rental is to be calculated which shall include every item of expense properly chargeable to manufacturing.

Conclusion on Spreading Systems.—No spreading system can attain theoretical accuracy. The degree of accuracy insisted upon must be conditioned by the demand for other virtues such as speed, economy, and simplicity. As Professor D. S. Kimball says "The method adopted should be as simple as the problem will permit. Thus, it would be folly to install an elaborate machine-rate method in a continuous process plant manufacturing a single commodity, where a percentage-on-material method is amply accurate Again, in cases where a few lines of goods are made on small machines of low value, the percentage-on-wages or the hourly burden method may be fully adequate Where the lines of production vary widely in size and character these simple systems are not sufficiently accurate, and a careful manager will go as far as he can in the direction of a machine rate."[1]

THE GROUPING OF COSTS TO PROMOTE EFFICIENCY IN PRODUCTION

The Cost of Idle Plant.—The most revolutionary idea which is at present at work in the world of cost accounting is the contribution of the late H L Gantt Briefly put, this idea is that "the cost of an article should include only those expenses actually needed for its production, and any other expenses incurred by the producers for any reason whatever must be charged to some other account"

Mr. Gantt led up to his idea in the following manner "Let us suppose that a manufacturer owns three identical plants, of an economical operating size, manufacturing the same article—one located in Albany, one in Buffalo, and one in Chicago—and that they are all running at their normal capacity and are managed equally well. The amount of indirect expense per unit of product would be substantially the same in each of these factories, as would be the total cost. Now suppose business suddenly falls off to one-third of its previous amount and the manufacturer shuts down the plants in Albany and Buffalo, and continues to

[1] Principles of Industrial Organization, D S Kimball, N Y McGraw-Hill, 1913, p 138

run the one in Chicago exactly as it has been run before. The product from the Chicago plant would have the same cost that it previously had, but the expense of carrying two idle factories might be so great as to take all the profits out of the business, in other words, the profit made from the Chicago plant might be offset entirely by the loss made by the Albany and Buffalo plants.

"If these plants, instead of being in different cities, were located in the same city, a similar condition might exist. . . .

"Instead of considering these three factories to be in different parts of one city, they might be considered as being within the same yard, which would not change the conditions. Finally, we might consider that the walls between these factories were taken down and that the three factories were turned into one plant, the output of which had been reduced to one-third of its normal volume In such case it would be manifestly proper to charge to this product only one-third of the indirect expense charged when the factory was running full" [1]

In another place he continues: "It does not require any knowledge of cost accounting, bookkeeping or other office art to enable the practical man to say that costs should include only those expenses needed to produce the article in question, and that those persons who insist on including in their costs expenses which do not contribute to the production of the article are simply trying to recover from the public through a higher prices the expenses which they incur through inefficiency and waste."[2]

The usual method of handling expense adds to the cost of making the cost of not making, and calls the sum of the two the cost of making It adds to the cost of working the cost of idling, and calls the product of the two the cost of working This system, intended primarily as a guide in price fixing, breaks down in slack times when price fixing is most important At such times it produces the ridiculous situation that a factory working on part time may accept orders at less than cost and improve its financial conditions by doing so

Mr Gantt's rule for dividing indirect expense is: "The indirect expense chargeable to the output of a factory should bear

[1] Organizing for Work, H L Gantt, N Y Brace & Howe, 1919, pp 29–35

[2] Idem

the same ratio to the indirect expense necessary to run the factory at normal capacity, as the output in question bears to the normal output of the factory "[1] It is necessary to determine, on the basis of a review of experience extending over a series of years, what the normal schedule of a factory is, and what the normal charge for indirect expense is. When the factory is working at less than its normal schedule, the idle-time expense which remains, after the product has taken its proportion of the indirect expense, can be charged to profit and loss. But since, in slack times, the profits are least or disappear entirely, it is desirable to set up a reserve account, and make contributions to it in periods of normal schedule, by slightly overcharging for indirect expense by means of a supplementary rate. In slack times this reserve account will be decreased by idle-time charges debited to it By this means the profits available for dividends will be somewhat regularized.

Analysis of Causes of Idle Time.—Mr Gantt did not stop with the effort to free the production executives from the unjustifiable load of idle-time plant charges, which had often buried the evidences of their best work under an avalanche of miscellaneous items, but he devised and put into operation recording agencies for bringing to the attention of the management daily the amount of idle time of equipment, together with a tabulated statement of the causes. For the collection of this information he devised a special chart, called an "Idleness Expense Chart," with spaces showing the percentage of capacity employed daily in each department, together with columns showing the idle-time expense in dollars and cents, for each specific reason in each department. The reasons he classified as lack of work, lack of help, lack of or poor material, repairs, and poor planning.[2]

The General Administration of Accounts

Mr. Church has defined cost accounting as a means of showing "The connection of expenditures of all classes with the items of output to which they are incident."[3] Proprietorship accounting

[1] Organizing for Work, H L Gantt, N Y Brace & Howe, 1919, p 35.

[2] This chart is reproduced and explained in Organizing for Work, H L. Gantt, N Y Brace & Howe, 1919, pp. 45–48

[3] The Proper Distribution of Expense Burden, A H Church, N. Y , 1908 The Eng. Mag Co , p. 13.

ultimately sums up all items of expenditure into its totals, but it does not measure the items near enough to their sources to reveal the relation between expenditure and return in detail. Cost accounting, on the contrary, is a scheme of measuring expenditures as close as possible to the time and place of the productive acts which give rise to the cost. The object of securing this record at the point of origin of the outlay is twofold, first, to get a record sufficiently dissected and analytical in its nature to reveal the relation between expense and output in detail, and so reveal the cost of a unit of product, second, so to measure the outlay on account of men, machines, materials, processes, gangs, departments, agencies, plants, etc., that when this record of costs is brought into comparison with a record of like detail and corresponding classification, showing useful work done, the efficiency of each agency of production can be measured Cost accounting is, therefore, an instrument of precision in the hands of the administrator it is one of the many special forms of scientific analysis available as a means of control

The Need of Better Cost Information.—There is need of much missionary work in industry to get rid of the system of basing prices upon "what the traffic will bear," and to install a system of pricing with reference to the cost of production. As a result of the examination made by the Federal Trade Commission into the leather and shoe industries the report said "It is a remarkable fact that such an extensive and well-organized industry was found to be lacking in accurate accounting methods "[1]

Similarly of the furniture manufacturers, the Commission said: "In spite of a very vigorous effort to obtain factory costs of manufacturers for specific articles of furniture the accounting records of the manufacturers were found to be of such a character that accurate data on this subject could not be secured "[2]

A good system of cost accounts is especially to be desired whenever costs are fluctuating, when high-priced labor or expensive materials are used, or when the margin of profit in an enterprise is narrow, so that selling prices must be set with care Ac-

[1] Report on Leather and Shoe Industries, August 21, 1919 Washington, Federal Trade Commission, p 165

[2] Report on the House Furnishings Industry, January 17, 1923 Washington, Federal Trade Commission, p 13

curate costs are useful as a sort of stethoscope for revealing the internal conditions of a business where much delegation of authority exists, or where proprietorship rests in the hands of persons not technically expert, and so unable to gauge efficiency by the process of intuition The early warning which cost records give of changing conditions is invaluable as a safeguard in disturbed and critical times, or when extraordinary expenses are being incurred, or when large contracts must be entered into on the basis of preliminary estimates. An establishment which makes a considerable variety of products can discover the lines which are most profitable, and so determine the true field of its enterprise and its proper function in the business world, only by a cost system It gives a great confidence to a salesman to be able to say to a customer or a prospective customer that a given price is absolutely just because it is based on carefully compiled cost figures

The Order System.—To ascertain costs it is necessary to bring under control all the activities in connection with which they are incurred, to the end that there shall always be a record where there is an expenditure Such control is obtained by establishing the rule that no expense is to be incurred without an order; and that orders go into effect through a prescribed method of authorization, and are concluded by a prescribed form of report.

In the shops an order system will mean that no materials can be secured except on a requisition bearing an order number, and that no workman's labor can be put on anything not specifically authorized, and accompanied by a job ticket bearing an order number. In the shops, each new lot of goods to be manufactured will require a new order, for there each order will expire as soon as work on the particular lot of materials or articles covered by it is finished

In the service departments and in the executive offices, where outlay cannot be directly coupled with any individual unit or lot of goods, the order will be, in reality, the title of a certain permanent class or subdivision of expense, under which each particular outlay is to be reported Such orders will be permanent, so that we may speak of a system of standing orders as prescribing a certain classification of items in all requisitioning and reporting

Some of the leading entries among standing orders will be additions to buildings, repairs to buildings, new equipment, repairs to equipment, department payroll, stationery, royalties, legal expenses, advertising, and insurance. The classification of these orders is important, since it conditions the analysis of expenditures, and so determines the ease or difficulty of throwing the expenditure into its proper class for spreading purposes.

Cost Accounting versus Proprietorship Accounting.—Cost accounting is a thing quite different from proprietorship accounting. The latter aims to show, by means of the balance sheet, what property there is at a given time, and what the claims of ownership are to it. By means of its trading, profit and loss, and revenue statements, it shows, in summarized form, what the receipts and expenditures have been for a period of time, what the profit or loss has been, and what disposition has been made of the profit. Proprietorship accounting keeps the records of financial relations with outside parties, as the law requires; it maintains a check on fraud, internal and external; it constitutes one proof, among others, as to where ownership lies; it shows whether or not the capital fund is properly proportioned between the various forms of fixed and current assets; and establishes the condition of a business with reference to insolvency and bankruptcy. Cost accounting, on the other hand, aims to collect all the items of outlay, great or small, incident to the production of a unit of goods or services It uncovers the causes of fluctuations of expenditures, and indicates the true field of profit. It aims to measure the efficiency of all the agencies of production, in so far as this can be done by the use of a scale of a monetary value. Proprietorship accounting admits only veritable original items: it balances its data in the form of debit and credit: and when in perfected form insists on the fine equilibrium of being balanced to a cent. Cost accounting freely uses estimates and averages, distributing sometimes more and sometimes less than it collects. One of these systems has had a long history, the other is of recent origin. One is the special instrument of the financier; the other is the daily working tool of the production engineer and works manager

In spite of these distinctions of aim and method, cost accounting and proprietorship accounting should be interlaced into one

harmonious system of financial records. The connection will be made through the introduction of the totals of the control accounts of the cost system as items in the trial balance and in the profit and loss account. Thus tied together, the cost system serves as an intensified study of certain items in the proprietorship accounts, while the proprietorship accounts serve as comprehensive surveys which make certain that all proper items have been introduced into costs.[1]

Uniform Cost Systems.—The practice of uniform cost accounting, by the individual establishments throughout an industry, has been defined by the Chamber of Commerce of the United States as follows: "Uniform cost accounting comprises a set of principles and in some cases of accounting methods which when incorporated in the accounting systems of the individual members in an industry will result in the obtaining of cost figures by the individual members of the industry which will be on a comparable basis. Uniform cost accounting does not mean the preparation of average or standard cost figures for the industry, nor the inclusion in costs of predetermined or fixed elements of cost."[2]

The establishment of a uniform system of cost accounting for the individual establishments in a branch of industry exerts a great influence toward stable conditions and friendly relations. Without such uniformity in the cost-calculating process, competition is not able, in the more complex industries, to establish agreement as to what fair cost is. Without it, therefore, a market can never reach anything better than an approximate and unstable equilibrium as to prices. The chief reason why unanimity of opinion as to costs cannot be reached, when different systems of accounting are used, is that there are many different ways of grouping and spreading overhead charges or factory burden. Even a comparatively simple item like the cost of raw materials may, in ordinary practice, include any grouping of a dozen or more

[1] For the argument that cost accounts and proprietorship accounts should be kept separate, see H P Gillette and R T Dana, Cost Keeping and Management Engineering, N. Y, 1909, pp 65–70 For the opposite view, see A H Church, Production Factors in Cost Accounting and Works Management, N. Y, 1910, Ch VII, pp 163–187

[2] Uniform Cost Accounting in Trade Associations, Washington, D C Fabricated Production Department, Chamber of Commerce of the United States, 1924, p. 4.

different cost elements The line between direct and indirect labor is not drawn alike in two plants In calculating the depreciation of buildings and equipment, some concerns use the straight-line method, or calculate a fixed percentage from the original value annually, others deduct a fixed percentage from an annually diminishing value, and still others make no regular allowance but either set aside lump sums out of profits from time to time, or trust to offsetting against depreciation the appreciation of such assets as real estate or good-will. With such diversity of practice it is apparent that competitors cannot act upon the same concept as to cost, and cannot, therefore, establish their prices in any definite and fair relation to cost. Profits are, therefore, arbitrary and uncertain, and not standardized as " converting profits."

It is well known that injurious competition often has its origin in the suspicious state of mind which is generated among rivals who do not know where the bottom rock of cost is. Rumors of cuts are given credence because the knowledge is not at hand to indicate their improbability, and such rumors are responded to more promptly because the folly of the action is not at once apparent

The introduction of a uniform system of cost accounts by a number of concerns in the same line of industry, as the result, perhaps, of the activity of a trade association, invariably brings these establishments into a state of intelligent reaction upon each other. Competition is not extinguished, though that abnormal form of it which consists in setting prices below cost may be discouraged. The interests of the public are better served in the long run, because the leadership toward lower prices comes from well-managed concerns of enduring power as factors in the market rather than from experimenters and price gamblers who exert but a temporary influence. Where costs are intelligently dealt with by a group of producers, the price pressure of the leaders bears down discriminately at those points where improved efficiency is possible for others

When once all the items of a normal and proper cost are enumerated and brought into clear view, the idea of maintaining fair prices becomes a sign of intelligent management, and even a point of honor. This as much discourages overcharging as under-

charging. By this means financing is made easier and capital flows in to work a greater ultimate reduction in price, through the effect of good equipment and production on a large scale, than disorderly market wars could ever effect. Managements are released from the excitement of commercial and financial experimentation, and set to work upon those matters which constitute the proper domain of manufacturing activity.

As the contact of business men in the same line becomes more educative, by reason of agreement as to the real nature of the contest being waged with cost, trade associations are strengthened. The discussions of business gatherings become less rambling and popular, and more vital and searching. The impulse which a group of business men in a similar line gathered together naturally feel to adopt a temporary panacea, and control the market by some artificial means, is replaced by a desire to use their assemblage as an occasion for studying efficiency.

The result of a system of uniform cost accounts in an industry is to work out a more rational division of territory between individual establishments in the same trade, and a better division of functions between allied trades. Unprofitable lines are more quickly dropped, unprofitable departments are more readily eliminated, and unprofitable establishments are more promptly closed This purging action releases much unnecessary capital investment, and cuts off much unnecessary operating expense.

PROBLEMS

Accounting versus Efficiency in Production.—In one of his writings, Mr Harrington Emerson has given the following account of an experience with accounting methods "In one of the largest manufacturing plants in the world, a group of efficiency engineers were introducing improvements and watching the record of tonnage costs In one department they had ascertained the average for May, June, July and August, had effected some changes in September and confidently predicted a reduction in cost of one dollar a ton on an output of 2000 tons in October

"With considerable glee the comptroller showed them that in October there was no reduction in cost per ton Amazed and disconcerted, they checked over the items and discovered a six-months' water bill of over $2000 which had been accumulating since the previous April and had been paid in October, and charged against the tonnage cost that month" What should have been done with this account? What

general principles should be laid down to prevent similar occurrences in the future?

The Function of Unit Costs.—In the same publication, referred to in the problem above, Mr Emerson gives the following experience: "In a plant manufacturing structural iron work, for many years the average cost per ton had been ascertained Most of the work had been large beams with few rivet holes and a small amount of fitting A large contract offering itself, a bid was made which was successful, based on the average experience of the past, as shown by the comptroller's records This job, however, consisted of pieces of small weight, requiring much fitting and many rivets It cost per ton almost five times as much as the comptroller's average, and in spite of most strenuous endeavors, the contract netted a severe loss"

How should the accounts of a corporation, bidding on contracts in this manner, be organized, to prevent such a loss as is described above?

The Machine Hour Rate.—If permission can be secured, make a study of a selected machine or production center to determine the total cost of a machine hour or a production-center hour With what information can be gained by observation and by the courtesy of the executives of the company, first construct as complete an analysis as you can of the cost elements which enter into the final hourly cost Fill out this analysis with actual or estimated costs, submit it to the officers of the company for correction or completion, and upon the final basis obtained, calculate the unit-time cost

The Cost of a Restaurant Meal—During the free-silver agitation, a book was published known as "Coin's Financial School" In one of the chapters of this book a farmer was pictured as eating a meal in a restaurant The price of the meal was paid by bags of various farm products So much was required that a large part of the space under and around the table was occupied by the materials turned over to pay for the meal The inference was that farm prices were unreasonably low, and restaurant prices unreasonably high Make as complete an analysis as you can of the elements entering into the cost of the typical restaurant or hotel dining-room meal Submit this analysis to local restaurant and hotel proprietors for revision and completion Then fill in the outline with actual, or estimated figures, and arrive at a final figure

The Cost of a Retail Delivery.—Make an analytical table, as complete as possible, of the elements of cost entering into the making of a delivery of merchandise to a customer's residence by a local grocer or dry goods merchant Use reasonable assumptions as to time consumed, distance traversed, equipment used, etc Follow the indications of the facts as to whether the final charge will be arrived at by means of an hourly

rate, a mileage rate, or otherwise Submit the analysis and the list of assumptions made to local merchants for criticism and completion

Motor Truck Mile Cost.—Make as complete an analysis as possible of the cost of operating a 3½-ton truck one mile Consider original cost, depreciation, repairs, upkeep, labor, rentals, gasoline, oil, tires, taxes, insurance, license, supervision, etc Make assumptions carefully as to days and hours of operation per annum, life of tires, life of truck, loading time, speed of movement, etc Submit the analysis to local trucking companies for criticism and completion, and deduce provisional figures This being done, secure copies of the Analysis of Truck Cost, Form 10, of the International Standard Truck Cost System, prepared (and for sale at 12 for 25 cents) by the Truck Owner's Conference, Inc , 5 South Wabash Ave , Chicago, Ill Report, showing your analysis and the Truck Owner's Conference analysis, and point out the differences Arrive at a final revised truck mile cost.

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CHAPTER XVI

THE WORK SCHEDULE AND FATIGUE

When an individual takes up a task the leading characteristic of which is the putting forth of physical energy on his part, there is at the beginning a brief introductory period of tuning-up—variously called the "treppe" from the German word meaning step, and the period of "practice effect" from the study of mental work—during which time production increases and the effort becomes easier and more agreeable. In this period certain physical and chemical changes take place in the muscles which better fit them for the immediate production of energy, the attention concentrates itself, and one becomes familiar with the feeling of the adequate muscular movements, and hence can control them more easily. The mind becomes refreshed as to the details of the work; and the grasp of facts as to layout and processes is made vivid.

Thereafter, as the work proceeds, production mounts more slowly, eventually reaching its maximum without material changes of sensation. A period of some duration may now occur, during which conditions are fairly uniform. One is now warmed up to the work, is habituated to it, has organized motions into chains, the elements of which have dropped below the threshold of consciousness, and is in the swing of an appropriate rhythm. Distracting ideas have faded away, dislike has disappeared or lessened, and one is absorbed.

Decline in production at first proceeds slowly, and then more and more rapidly, as pleasure fades, and effort, strain, and finally pain, make their appearance in consciousness. At first increasing slowly, these uncomfortable sensations intensify themselves more and more rapidly until, at length, the essence of the task becomes largely the putting forth of the energy of will required to combat them.

In the muscles the long slender fibers are bathed in lymph supplied from the blood. They have built up their structure and stored away functional substances according to the richness and purity of the blood, and the exercise which has been given them They are connected with the brain by nerves. Upon receiving the appropriate nervous impulse they shorten themselves and exert a pull upon the tendons. This they do at the expense of a certain amount of wear and tear to their structure, and the using up of stored substances previously elaborated against the time of call. Work results in the accumulation of toxic breakdown products within the fibers and in the surrounding lymph. The length to which activity can be continued depends upon the strength of the fibers, the quality of the food supplied through the blood from the digestive process, the freedom of the blood from the poisonous products of other muscles and tissues, as a result of the activity of lungs, kidneys, liver, and skin in purifying it, the rapidity or sluggishness of the circulation of the blood upon which the fibers depend for the out-drainage of wastes, and upon the opportunity to effect repairs Before the fibers are seriously damaged by work, the nervous system, acting as a sort of fuse, produces the disagreeable sensations known as fatigue "The nerve fibers, which carry impulses from the central nervous system to voluntary muscles, terminate in the latter in delicate 'end plates.' These end plates become 'fatigued' before the exhaustion of the muscular tissue can occur"[1] Fatigue is not so much overwork, as it is a safety device which prevents overwork.

Wholesome Fatigue versus Overstrain.—Fatigue has been defined as "The sum of the results of activity which show themselves in a diminished capacity for doing work."[2]

All degrees of fatigue are by no means evil

"There are a few modern occupations," says the Life Extension Institute, "where muscular fatigue is caused in a harmful degree in a healthy subject. . . . We should rather fear the other extremes in living that render us liable to fatigue than cultivate a fear of overwork itself" Passing beyond that reasonable fatigue

[1] Mind and Work, Chas S Myers, Director, Psychological Laboratory, Cambridge University, London, 1921 Putnam's Sons, p 37

[2] Interim Report, Industrial Efficiency and Fatigue, British Health of Munition Workers' Committee, London, H M S O, 1917, p. 8

which acts as a moral and physical therapeutic agency, it must be recognized that there is a point where, if labor is unduly prolonged, the exertion is too costly for the worker, too costly for the employer, too costly for society. This may be called the point of overstrain.

Signs of Fatigue.—The sense of fatigue is not a sign of complete loss of power of the muscular system, for laboratory experiments upon the excised muscles of exhausted animals have shown very large reserve power for doing work. As the sense of fatigue arises largely from nervous conditions, it is influenced by the attitude taken toward the task. A fatigued person—as a boy carrying in kitchen wood—may be suddenly galvanized to considerable exertions by the development of a new interest—such as the sound of the fire bells. Considerable loss of efficiency in working may take place in tasks which fascinate the worker, before fatigue is felt. On the other hand, a feeling of monotony and irksomeness may come while the power of working is still unimpaired or is improving. The feeling of weariness cannot be used as the single controlling sign in industrial task setting.

In the case of the milder degrees of fatigue, some of the symptoms are, that the ability to command the muscles in work is weakened, the tactile sensibility is lowered, the capillaries are relaxed—hence the flushed face—and the vascular skin reaction (Ryan's test) is quickened. Enunciation may be poor, handwriting may be enlarged and irregular, and the general body movements may lack coordination and be marked by awkwardness and inadequacy. The reaction time to various types of stimuli is likely to be lengthened. Standards are relaxed; and crude methods of working, normally outgrown, may reappear. With blundering work there is an increase of accidents, while indifference, which testifies to mental repose already begun, or bad temper and a feverish pace, which indicate toxic irritation, reveal the abnormal state of affairs.

Mr. James Hartness says, very aptly, "It is not well to try any new thought on a physically tired man." And he illustrates the progressive deterioration of methods incident to growing fatigue, as follows: "Suppose we take two men exactly alike in all respects, with exactly the same knowledge of work to be done, and let them together undertake to dig a ditch, or repair or

adjust an intricate machine, or any other kind of work. Let one of the men get in an awkward position to shovel earth or pull a wrench and become a trifle fatigued, either by the physical strain or the worry of the work, and let the other take a less strenuous part in the undertaking We will find that one has been changed into a progressive and the other into a conservative. The man who is tired from the strenuous part of the work cannot see why the other should suggest digging around a boulder instead of lifting it out of the ditch bodily, or why it may not be necessary

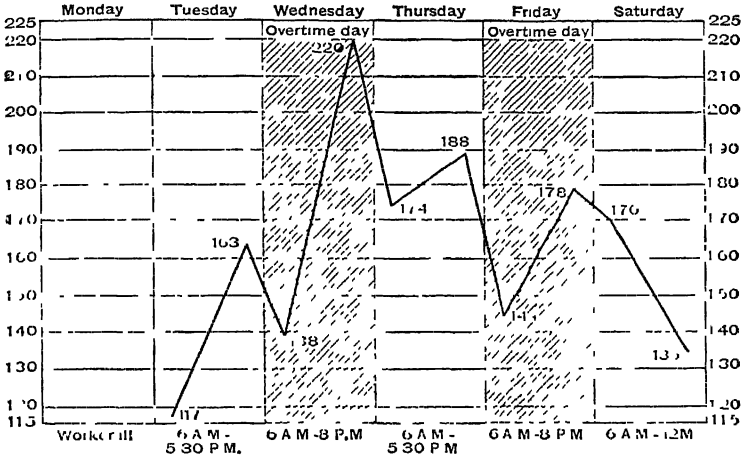

Fig 37.—Reaction Time to Letters

to dismantle the whole machine in order to discover the fault. He cannot tolerate any suggestion of a new method of working. It is actually easier for him to do the work by the more laborious but 'habit' method." [1]

Measures of Fatigue.—There are various measures of fatigue upon which the physiologists are working, and which may presently be sufficiently perfected so that they can be used by the properly trained factory expert, as safeguards where large tasks are prescribed. Such a test is the measurement of the blood pressure. As a general rule slight fatigue is accompanied by a rise in blood pressure. Another test is the acuity of hearing.

[1] Human Factor in Works Management, James Hartness, N Y. McGraw-Hill, 1912 pp 50–51.

A worker may be tested by establishing the difference at which he can hear a watch ticking in the morning and the evening. The more the distance is shortened the greater the fatigue. Similarly the acuity of sight may be tested by the distance at which letters printed on a card can be identified in the morning and the evening As before, the more the distance is shortened in the evening the greater the fatigue. Another test has to do with the length of the reaction time to letters or colors. The employee is shown several letters in succession. Whenever the letter agreed upon comes into sight he presses an electric button which makes a record. The elapsed time between the signal and the response is measured in hundredths of a second. Two tests are made, one in the morning and one in the evening. Fatigue lengthens the reaction time. A chart is here reproduced which shows the record made by an English worker during a week with one day of illness, three normal days of work, and two overtime days.[1]

Tests of more practical value to the works manager or time study man are the rate of labor turnover, the extent of absenteeism, the spoiled work records, and the voluntary rest periods taken by employees, either for visits to the rest room or in the form of soldiering, the records of production (especially during the closing hours of the day, and the latter days of the week), and the general attitude of employees toward their tasks and toward the management. The accident record classified by hours of the day and the days of the week is of special significance.

Recovery from Fatigue.—Rest is in reality a period of activity in the body. Waste products are then eliminated and the nervous and muscular tissues are reconstructed. This process of recuperation is one requiring time. The amount of fatigue which may safely be incurred depends, therefore, upon the period which can be given to recuperation. From moderate fatigue, recovery is rapid and complete, the replacement being with stronger tissue, so that power is increased by use. From great fatigue, recovery is slow and, as age increases, less and less complete. The continuance of labor, after strain makes its appearance, causes a destruction of muscular and brain cells which increases more

[1] Second Interim Report on an Investigation of Industrial Fatigue by Physiological Methods, A F S Kent, London, 1916 Home Dept, H M S O (Cd 8335), p 15

rapidly than output, and so disproportionately lengthens the period required for recovery. The tendency of the most advanced factory management is to avoid any serious compounding of the effects of work by using numerous brief rest periods during the day.

The Control of Fatigue

General Shop Conditions.—It is to be understood that the providing of excellent conditions for work is a part of any program of fatigue elimination. An abundance of well-diffused illumination, and a system of ventilation which will keep the atmosphere fresh and invigorating, are required if the human machine is to work at its best. If workrooms are too cold, the fingers, upon which so much depends, are benumbed. If they are too hot, the blood is brought to the surface of the body to cool and to operate the sweat glands. Thus it is withdrawn from circulation through the working muscles Fatigue products are, therefore, not promptly carried away and fatigue comes much more quickly. Noise and vibrations which distract the attention from the work exhaust the nervous system so that—fatigue symptoms being nervous symptoms—fatigue comes sooner. It is poor economy to give to workers so little information that they do not know exactly what is wanted and the one best way to achieve it A process which is imperfectly understood, at which the worker struggles mentally, and over which he worries as he works, will mean unnecessary use of energy. The risk of accident is a very important matter, for it is one of the chief causes of anxiety in the wage-earner's life. Every accident in a shop at once increases the difficulty of working for every operative, and starts a flow of nervous energy in the form of worry Clothing should be comfortable, should withdraw the mind from rivalries as to apperance, should be loose enough to offer no obstruction to circulation, but trim enough in design to offer the fewest possible opportunities for entanglement in the moving parts of machinery.

Design of Equipment.—So long as administrators have created the conditions under which it has been more troublesome and more dangerous and less profitable for the workman to call attention to the conditions which interfere with production, than to retard the pace by slipping in secret recuperation periods through-

out the day, just so long soldiering has served to hide from the management a world of badly planned processes, and has covered with a mantle of secrecy the bad design of machinery. If a wrongly placed lever has called for more fatigue than the laborer could regularly absorb at the pace which the demonstrator, who represented the manufacturer of the machine, used for a brief test, there has been the opportunity of interposing unnecessary stoppages when the head of the boss was turned. Thus the machine has continued to seem the acme of perfection to its builders although, for mysterious reasons, the users have never achieved the expected results. It is quite possible for the minds of operatives to be full of the knowledge of defective processes and imperfect equipment, but for the management never to get access to this stock of knowledge, because it has never devised a plan of administration and a system of rewards which made frankness safe between management and men with reference to the factor of fatigue.

Analysis of Motions.—In the chapter on "Layout" under the paragraph heading, "The Production Center," and again in the first chapter on "Scientific Management," under the heading, "Motion Study," the problem of the efficiency of the production center has been referred to. The critic who hopes to introduce economies by the analysis of work motions should develop the habit of using only efficient motions and layouts himself. This will make inefficiency more noticeable wherever he may encounter it. He can practice at will in his own exertions,—as in dressing, in packing, in doing repair jobs about the home, in working in a garden, etc. He can sharpen his powers of analysis by observing what goes on around him, as in the work of preparing a meal in the home, in the movements of a carpenter on some nearby building, or in the trucking operations carried on about the city streets Motion study has to do with one of the fundamental efficiencies. The practice of it is very interesting, furthermore, it tends to bring other efficiencies in its train.

The height of work at a work place should be a little below the level of the elbow. The distance across a work table should be only slightly more than the reach of the extended arm The experiments of the British Industrial Fatigue Board indicate that, for a man of average height, the most advantageous initial height

of a weight which is to be lifted is between 25 and 30 inches from the floor.[1] They indicate also that for carrying weights the old-fashioned yoke is far superior to any other device.[2]

Chairs should be provided for all operations which can be carried on in a sitting position: and this is advisable because of the great relief of being able to alternate between sitting and standing positions[3] To permit this alternation, the height of the operator should be the same when sitting as when standing. This means that foot rests should be provided, they should be placed not only at the front of the seat but on the sides as well. Factory and office chairs should be adjustable as to the height of the seat from the floor and the distance from the seat to the foot rests. Care should be taken not to have the depth of the seat of the chair so great that the back can only be used by cutting off the circulation in the legs.

Mr. Gilbreth found that when both hands were used in work, they should begin and end movements at the same time. As far as possible such movements should be in opposite and symmetrical directions, to avoid destroying the balance and putting the muscles of the trunk under strain. The observer should note whether there is a marked movement of the trunk of the body (as in bending and stooping) or of the whole body (as in squatting) which can be avoided. He should ascertain what the weight of material is which is moved by the operative at one time.

A general body movement at intervals, if not required in the work, may be justified on other grounds It is sometimes stated in motion study literature that the fewest, simplest, and most direct motions are the best. Experiments bearing on fatigue have shown that accompanying movements not strictly necessary for doing the work may be very advantageous, if they stimulate the circulation of the blood through the muscles upon which the brunt of the work falls Under the direction of the British Industrial Fatigue Research Board, a series of experiments was carried out by a subject who pulled upward upon the handle of a dynamometer It was found that some unnecessary slight

[1] The Effects of Posture and Rest in Muscular Work, Industrial Fatigue Research Board, London H M S O , 1924, pp 32 and 53

[2] Ibid , pp 17, 18, and 23

[3] Ibid , p 52, on the value of changing posture during work

shoulder movements improved the circulation through the burdened muscles, and caused a more rapid removal of fatigue products.[1]

Selection of the Worker.—In all work, whether mental or physical, native aptitude, training, and the facility of habit are highly important as means of reducing fatigue. Of purely mental calculations, Professor Thorndike says, " Greater achievement per hour means less, and much less, fatigue per hour." [2] A woolen manufacturer reporting to the Tariff Board on the causes of the difference of output of weavers said: " The good weaver never seems to be doing anything; the poor weaver always appears to be hard at work. The good weaver is quietly on the alert for things to happen; the poor weaver is always fussing around to catch up after they happen; consequently the good weaver not only produces more work but better work than the poor one." [3] Another manufacturer said: " It is not a question of quick motions. One of the best weavers we have is a man of very slow, almost sluggish motions. One of the poorest we ever had was a nervous, quick-motioned man. The first made every move count; the second made three unnecessary moves to one that was useful. We believe the same types will be found anywhere in any line of work." [4]

As to natural differences among workers in pace of working, Mr Edward Cadbury has testified, on the basis of much experience. "After a good deal of experience with thousands of piece-workers it has been found that from 5 to 10 per cent have a natural gift for speed, and will always earn about 20 per cent above the average, upon whatever process they are engaged These workers pay the employers best, and should be encouraged, and an enlightened employer will never grudge them the extra money they earn Again about the same percentage are slower than the rest."[5]

[1] The Effects of Posture and Rest in Muscular Work Industrial Fatigue Research Board, London, H M S O, 1924, p 53

[2] Mental Fatigue, Edw L Thorndike, Journ of Ed Psych Vol 2, p. 69.

[3] Report of the Tariff Board on Schedule K, Washington D. C. Govt. Print, 1911. Vol. 4, p 1074

[4] Ibid, p 1073.

[5] Experiments in Industrial Organization, Edward Cadbury, N Y. Longmans, 1912, p 141.

Health of the Worker.—An unhygienic life followed by the worker outside of industry is sure to manifest itself by the incompetency signal of fatigue at the task As the Life Extension Institute has said: "It is as important to know a man's condition before he commenced work and what he does when not at work as it is to find out how much work he is doing and measure the fatigue which follows it Often when a person complains of being exhausted it is not the work itself that causes the exhaustion. He may be failing to observe a proper balance in the division of his time or he may be living an unhygienic life." To the same effect Prof Thomas A. Storey says, "The most important influences for the prevention of and recovery from fatigue are the influences of wise habits of nourishment, wise habits of excretion, wise habits of exercise, and wise habits of rest." [1]

Referring to what was said at the beginning of this chapter of the muscle fiber and its dependence upon the blood for its food and for the out-drainage of its wastes, it is apparent that the ability of the worker depends upon the strength he has stored up in his tissues, and the ability of his lungs and blood to furnish oxygen and food to the tissues, and the ability of his circulation and elimination to dispose of the poisons produced by exertion. The strength depends upon proper diet, the avoidance of overeating, and rapid eating, and improper food, and upon the full utilization of the sugars of the diet uninterfered with by fermentation in stomach and intestines from bacteria conveyed by dirty hands or dirty dishes or bad teeth. The supply of oxygen has to do with deep breathing, and proper posture, and fresh air in bedrooms. Drainage and elimination of wastes raise questions as to bathing, constipation, obesity, weakened heart, hardened arteries, etc. Nine out of ten times, fatigue has some story behind it of improper home conditions, worry, dissipation, specific disease, irregular hours, or an undue load of outside activities. "Inasmuch," says Dr Eugene L. Fisk, of the Life Extension Institute, "as physical examinations have shown that more than 50 per cent of any group of industrial workers are in need of medical attention, this enormous factor which has been practically ignored in fatigue studies is entitled to first instead of last

[1] Why Workmen Tire, Thomas A Storey Factory, April, 1912

place. . . . The threshold of fatigue is lowered in the substandard individual." [1]

Speed of Working.—Let us consider the qualities of work, from the standpoint of fatigue, under three headings, namely speed, stress, and continuity. The fatigue caused in accomplishing a given physical effect is a function of the speed of performance. This may be seen in the difference between the result of walking a block and of running a block. It is not a simple function, however, for exceedingly slow speeds involve a large expenditure of effort for the result achieved, because of the energy which is absorbed in maintaining a posture. In general, as speed increases fatigue is more than proportionally increased, because the disorganization of tissue more and more outruns the processes of drainage, oxygen supply, and repair.

The speed standard which is involved in the ordinary labor contract is an extremely vague conception expressed by the phrase "a fair honest pace." The actual pace which results from the equilibrium established between the employer's foremanizing and the employee's soldiering differs from shop to shop, and is sometimes spoken of as "the habit of the shop."

Ideally this pace should be full of snap, and expressive of healthy energy, bringing with the accomplishment a glow, and preparing the way for true repose. It should be enough of a trial of powers to hold the attention from vague wandering, and to stimulate the mind to conceive better methods.

The pace should be such that the worker's conscience can be clear, and that he can spurn the humiliation of speeding up under the eye of the boss, and of soldiering when his back is turned. Such a pace is popular with men who are fit. Gen. Andrews, in his book addressed to young military officers, says: "Every man delights in work well done, in actually doing well what he puts his hand to. Remember this when you direct the drill or work of your men. They enjoy being snappy, being efficient, doing the right thing at the right time, avoiding wasted time or energy—and they are disgusted with the reverse of these." [2]

[1] Fatigue in Industry, Dr Eugene L Fisk. American Journal of Public Health, March, 1922, pp 215–217.

[2] Fundamentals of Military Service, Lincoln C Andrews, Philadelphia Lippincott, 1916, p 15

On the other hand, the proper pace is entirely different from the fastest speed in which a task can be done. The latter is of interest in college games, but is not applicable in industry, except in such rare emergencies as fighting a fire or a flood All conceptions of what is possible for the worker to deliver in the form of daily performance, and still maintain his health and vigor, are subject to an indefinite deduction so that the worker shall have a reserve of energy with which to enjoy his life outside of the hours of work.

Stress of Work.—By stress is here meant the degree of the intensity of effort. The safe limits of stress are a subject for the inquiry of the physiologists, as when the British Industrial Fatigue Research Board tentatively suggests that "the continuous carrying of a load (by women in factories) exceeding about 35 per cent of body-weight, if so disposed as to disturb normal poise and movement, is likely to cause rapid impairment of working capacity." [1]

The law of economy dictates that the load should be as large as the mechanism is built to carry as a safe load. As the British Industrial Fatigue Research Board says, "Any organism or inanimate machine is, of course, most efficient when running at the full capacity for which it is designed Similarly, on various grounds, it is undesirable that the 'human machine' should work much below its capacity " [2]

The Intermittency of Labor.—Many works managers and foremen of the old type have thought, without stopping to examine into the matter, that since they are offering "steady" employment and not work by the job, and since the pay is calculated for a continuous stretch of time, that, therefore, labor should be continuous throughout the day. In many manufacturing shops and retail stores it has been considered an offense for a workman or a clerk to sit down, although the task does not, at the moment, require standing.

How low the intelligence of the bossing of factory-yard labor usually is may be inferred from the experience of Whiting Williams He relates "Only one thing we could not do. We could lean on

[1] The Effects of Posture and Rest in Muscular Work, Industrial Fatigue Research Board, London H M S O, 1924, p 26

[2] Ibid, p 24

our shovels to our hearts' content and gaze off at the sky-line or toward an occasional aeroplane, *but we must not sit down.* This rule seems to be general among bosses, and many workers will not give him a chance to find 'em at it Whenever possible, I have tried it and usually found it drew a call-down Here it brought a gob of mud from the boss, followed by a firm but decent call-down, and finally, on the second offense, a threat of firing

" Where men are being paid for purely muscular energy, the wisdom of this prohibition is certainly to be questioned. Surely an occasional ' spell ' or let-down could be permitted in a way that would secure a bigger day's work for the company than the usual day of unbroken, but extremely slow-speed effort—especially if tried with a higher type of gang boss than seems common "[1] This is very different from Taylor's method with the yard men at the Bethlehem steel plant, where clerks were hired to watch the time and see that the laborers sat down and rested at frequent intervals.

All human energy is intermittently developed Rest periods have been imperative where performance has been anywhere near the efficiency point And so workers have been obliged to slip in recuperation periods by deceit.

In any occupation where the nature of the operation provides relief and variety, the introduction of rest periods by authority will be less essential. With ordinary managements there is much natural intermittency, as the workman hunts for or waits for materials, as he makes machine adjustments or repairs or waits for them, as he hunts for tools or goes to a tool room for them, or waits in line at the grinder to grind them, or as he waits for the boss to assign the next job, or give him instructions, or inspect the work finished. These delays and idle periods may far surpass physiological needs. But in occupations where there is a marked monotony or continuity, or where a fast pace, or considerable stress is aimed at, the situation is different, and administrative control of intermittency of work is called for.

The vast majority of the rest periods employed in American industry are simple breaks which can hardly be called anything more than recesses. Most of these are mid-morning and

[1] What's On the Worker's Mind, Whiting Williams, N Y, 1920 Scribner, p 187

mid-afternoon pauses of from 5 to 15 minutes duration [1] These recess periods eliminate the mid-morning practice of eating in the shops, followed by workers who have left home before the family was up to get breakfast, or who have eaten little and that hurriedly. They also take the place of voluntary unregulated rest periods taken by employees—especially women—for visits to rest rooms. The introduction of a recess is often opposed by piece workers for fear that earnings will be reduced. The effect, however, is usually to increase production. The full benefits of rest periods can be obtained only by stopping the machinery and requiring employees to leave their work places

When a high-grade performance is aimed at, as in connection with the installation of scientific management, there must be careful control of the factor of intermittency, or of the schedule of work and rest periods, if the danger of overfatigue is to be avoided. What is required is a very intimate alternation between brief work and rest periods, so that fatigue may constantly be checked in its incipient stages. Most of the intricate programs of work and rest at present in use appear to owe their origin to the stimulus of scientific management, and to the accurate and detailed studies of tasks made by time study experts Mr. C. E. Knoeppel started with workmen who, at their own gait, had been producing 16 pieces per hour By establishing a 25-minute working period and a 5-minute rest period, he obtained 18 pieces. By changing to 17 minutes of work and 3 minutes of rest the output rose to 22 pieces per hour. Finally, by arranging a 10-minute work period and a 2-minute rest period, production became 25 pieces [2] In another case where a record of driving 1600 rivets per day was obtained, the previous performance having been 600 per day, Mr H F. Stimpson established rest periods of 2 minutes between each 10 rivets, thus devoting 320 minutes, or 5 hours and 20 minutes out of the 10-hour day to rest, and employing a schedule of $1\frac{3}{4}$ minutes of work and 2 minutes of rest [3]

[1] For tabulated information concerning a large number of them consult Rest Periods for Industrial Workers, Boston National Industrial Conference Board, 1919, pp 47–55

[2] The Psychology and Ethics of Wage Payment, C E Knoeppel, p 9

[3] Hearings before the H of R Sp Com on The Taylor and Other Systems of Shop Management, Washington, D C, 1912, I, pp 663–664

Frederick S Lee summarizes the careful experiments of Jules Amar on the operation of metal filing, from which it was found that, "The operation should continue five minutes and be followed by one minute of complete rest during which the arms should hang at the sides of the body." [1] Lee also gives the incident, so often reported elsewhere, of the rival squads of soldiers digging a trench. "The value," he says, "of resting periods is strikingly illustrated by a British incident, in which two squads of soldiers, equal in number, were ordered to dig equal lengths of a certain trench. All the men of one squad worked continuously and as hard as possible. The men of the other squad were divided into groups, and each group dug strenuously during five minutes and then rested ten minutes. This organized squad easily finished its job first." [2]

The rest period which endures beyond a few seconds should involve cessation of demand upon the used muscles, the exercise of other muscles to stimulate out-drainage, and change of interest to switch mental activity to unused centers of the brain. On the use of the rest period the British Industrial Fatigue Research Board says: "When a rest pause is taken in the course of industrial work, it is important that the posture should be changed, even if the pause lasts only a minute. That is to say, operatives who have to stand at their work should sit down on as comfortable a seat as possible, whilst those who sit at their work should stand up and, still better, if it can be achieved without inconvenience, should walk about. Thereby the circulation through fatigued muscles is promoted, and fatigue diminished." [3]

Administration and Fatigue.—As the laws of fatigue become more accurately established through scientific investigation, industrial managers will be held to closer account by public opinion What is already known is sufficient to demonstrate the fact that the regulation of the pace is too complicated a matter to be left in the hands of the operative. Speed, stress,

[1] The Human Machine and Industrial Efficiency, Frederick S Lee, N Y Longmans, 1918, p 98

[2] Ibid, pp 27–28.

[3] The Effects of Posture and Rest in Muscular Work, Industrial Fatigue Research Board, London H M S O, 1924, p 52

and intermittence are compounded in infinite variety in different kinds of work If high records of production are to be attained with safety, these variables must be under scientific control. Pacemaking has always been recognized as an important factor in athletics, where brief tests are made with contestants who are in the elastic period of youth. Although industry aims at no such strenuous performance as competitive athletics involves, it can derive suggestions from the best practice of trainers in safeguarding contestants. Pacemaking is much more important in industry than in athletics when the object is to determine the stroke of the nation's industry, and to set a pace which shall be wholesome as the habit of a lifetime.

The Schedule of Hours

The Schedule of the Week.—If the output of any given class of employees be plotted by the days of the week, the resulting

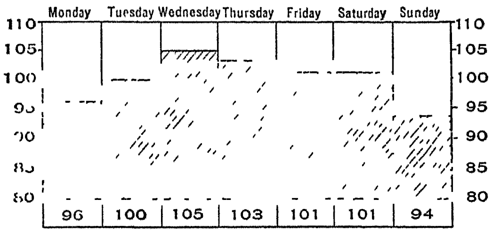

FIG 38 —VARIATIONS IN RATE OF BLAST FURNACE CHARGING [1]

diagram will throw some light upon the question of the relation of the schedule of hours to the physiological processes involved in producing fatigue. If recovery from fatigue is not completed between each two days by the intervening night's rest, there will be a falling off of production during the latter part of the week, and the best day will be thrown forward in the week. In the case of heavy work, the best day may be Wednesday. This may be illustrated by a record of blast furnace charging shown in Fig. 38 Inasmuch as this is a seven-day working week it is interesting to note that the employees take a voluntary week-end rest by

[1] Second Annual Report of the Industrial Fatigue Research Board, London H. M S. O, 1922, pp 31–32.

low output on Sunday and Monday. For lighter work Thursday or Friday may be the best days. This may be illustrated by the operation of shoe lasting, which is shown in Fig 39. In this case it can be seen that the employees are making a partial holiday out of Saturday by reduction of output. To interpret charts of weekly production it is necessary to allow for disturbing

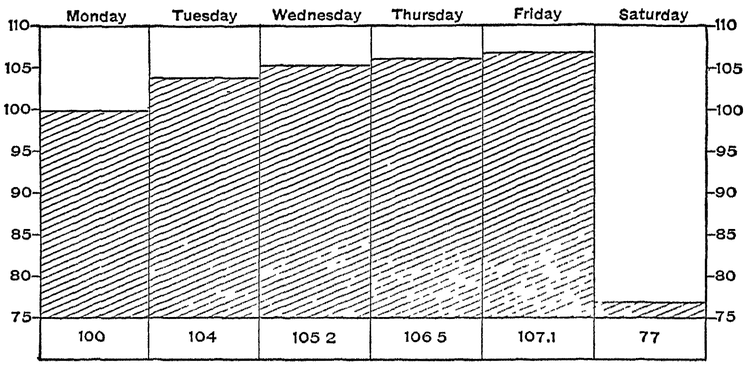

FIG 39 —VARIATIONS IN RATE OF SHOE LASTING [1]

influences, such as temperature, humidity, the use of artificial light, etc.

The British Industrial Fatigue Research Board carried out, during the war, extensive observations as to the influence of different total hours of work per week upon output

The hours covered by the studies of the British Board ranged from 45 to 75 per week Stating some typical results in general terms, and disregarding minor fluctuations, 40 women milling a screw thread did as much in a 48-hour week as in a 65-hour week, 90 women turning fuse bodies did as much in a 44-hour week as in a 66-hour week, 15 youths boring cap tops did as much in a $54\frac{1}{2}$-hour week as in a $72\frac{1}{2}$-hour week, 56 men sizing fuse bodies did as much in a 46-hour week as in a 58-hour week.

The most important result which appears to be shown by these records is the remarkable one that, where output is under the

[1] Second Annual Report of the Industrial Fatigue Reseach Board, London, H M S O, 1922, pp 31–32.

employee's control, and not fixed by the speed at which machines are operated, and where output is not standardized as under scientific management, or by the force of a union sentiment, it makes little difference within wide limits how long the employees are held in a factory per week by the schedule of hours, for the weekly output of work tends to become the same This means that a change to shorter hours will eventually be met by an increase of pace sufficient to offset the loss of hours.

Hours per Day.—If the output of any class of work be charted by the hours of the day, the resulting figure will usually disclose low production during the first hour of the morning, and a quick increase in the second and third hours, ending in a decline during the last morning hour. The afternoon output will usually begin at about the rate of the last morning hour, or a little below, and will then, if the work is not heavy, make a climax for the afternoon, or, better still, for the day in the second hour, after which it drops, at first slowly, and then more rapidly toward closing time The depth of the dip before the noon hour and the rapidity of the flattening out in the afternoon will reveal something of the physiological state of the workers. With a short day, or a day of light load, production is sustained at a more nearly uniform rate throughout.

Night Shifts.—Leaving out of account those lines of production, such as the blast furnace industry, in which operations cannot be suspended for mechanical reasons, and those like the newspaper industry, where production is confined within narrow time limits, the chief argument in favor of night work is to exploit equipment more continuously, and so lower the overhead charges per unit of output There are, however, so many disadvantages in the plan that this gain appears usually to be nearly, if not quite, counterbalanced It is a distinct disadvantage that production is from 5 to 15 per cent less than in day shifts, falling to a very low ebb in the early morning hours Fine work suffers from the necessity of working by artificial light, wages are higher, and the quality of personnel is inferior, both workers and supervisory staff not being up to the standard of day shifts Night workers do not get undisturbed sleep, and hence are more or less fatigued. They are subject to digestive disturbances from eating cold or stale food, because their meal times do not correspond with those

of day workers. Attendance is irregular, and accidents are more frequent than on day shifts.

Overtime.—Overtime partakes much of the nature of night shift work. It has been called "physiologically extravagant." Like night work, it is characterized by a slowing up of pace, and this applies not only to the overtime period, but to the regular hours as well. It tends to increase of labor turnover, absenteeism, accidents, sickness, and the production of off-grade goods. It is as hard on executive staff and foremen as on operatives. Its frequent use is a more or less shiftless substitute for careful scheduling of production to meet promised deliveries, and careful employment activity to keep the working force in balance, and provide a spare force to act as a flying squadron for keeping production in balance The wages required for overtime work are commonly 50 per cent in advance of regular rates. The attitude of the American Federation of Labor is that overtime should be "prohibited except under the most extraordinary emergencies."

Problems

Output and Hours of Work Per Week.—Construct with cross-section paper a large-scale chart Lay out a horizontal scale, representing length of time, with positions for each hour, from 40 hours (at the right side of the chart) to 75 hours (at the left side of the chart) Construct a vertical scale to represent percentages of relative hourly output, with positions for each per cent, beginning with 100 per cent at the bottom of the chart, and ending with 160 per cent at the top Upon this base construct three curved lines (more if desired) representing equal total weekly output, beginning with 100 per cent for 55 hours, 65 hours, and 75 hours

Upon this as a background (preferably in red) chart (in black) the quantities found in the table below, representing average relative hourly output, at the proper distances above the base line, having reference at each step, to the proper position in the hourly scale, indicated by the corresponding figures in the column of average actual hours per week When for a group of workers the positions have been located, connect them with a record line, and identify with a legend

The records here shown are based upon a series of experiments made under government supervision, in England, during the World War, in varying the weekly hours of labor Upon the basis of the showing made by the diagram prepare a statement of the influence which the number of hours of work per week has upon the total output per week

56 MEN SIZING FUSE BODIES (Heavy labor)		40 WOMEN MILLING SCREW THREADS (Light labor)		15 YOUTHS BORING TOP CAPS (Light labor)		90 WOMEN TURNING ALUMINUM FUSE BODIES (Moderately heavy labor)	
Average Actual Hours per Week	Average Relative Hourly Output	Average Actual Hours per Week	Average Relative Hourly Output	Average Actual Hours per Week	Average Relative Hourly Output	Average Actual Hours per Week	Average Relative Hourly Output
58 2	100	64 9	100	72 5	100	66 2	100
50 5	122	55 4	109	69 1	106	53 4	123
52 1	119	54 6	114	54 8	108	54 8	134
46 3	123	54 8	121	54 7	117	50 0	132
47 6	135	45 5	121	47 4	124	47 0	124
51 3	137	48 1	133	54 5	129	49 9	135
51 2	139			51 7	126	48 3	144
						45 6	158

Fatigue and the Recognition of Letters.—In one of the early experiments made, to discover a measure of fatigue, six coal miners were examined at the beginning and again at the close of work each day for a week. The test was the maximum distance in centimeters at which standard letters could be recognized The records obtained were as follows (BW = Before Work AW = After Work) Page 386, upper tabulation

Provide a large-scale chart on cross-section paper, making time the horizontal dimension, and making distance above the base line represent centimeters from 0 to 750 Plot upon this base, in light lines, the records of the measurement of each miner Plot with a heavy line the average distance scored by the six men at each measurement Indicate to what extent the test appears to be a reliable measure of fatigue

Influence of Fatigue upon Blood Pressure.—An effort was made several years ago to determine the amount of fatigue incurred by workers by observing changes in the blood pressure. Six coal miners were measured for each work day of a week Two measurements were taken daily, one at the time of starting work, and one at the close of work The records obtained, giving the blood pressure in millimeters of mercury, were as follows Page 386, lower tabulation

Construct a large-scale chart with variations in the blood pressure represented by distance above the base line, and time represented by the

PERSONS	MONDAY		TUESDAY		WEDNESDAY		THURSDAY		FRIDAY	
	BW	AW	BW	AW	BW	AW	BW	AW	BW	AW
J J. L	76	60	66	72	74	55	64	50	60	54
F T...... .	610	593	602	600	641	610	645	571	600	515
G C.. .	252	182	343	220	369	300	367	143	164	122
J W B.....	503	426	626	517	564	563	569	476	575	444
D W L	300	175	277	300	169	146	286	227	216	171
S M..	595	544	666	600	732	620	686	636	675	618

PERSONS	MONDAY		TUESDAY		WEDNESDAY		THURSDAY		FRIDAY	
	BW	AW	BW	AW	BW	AW	BW	AW	BW	AW
J J. L ...	149	158	138	162	148	152	147	148	148	154 5
F T	128	141	129	134	134	130	133	132 5	134 5	127
G. C .	141	145	145	137	141	143	140	143 5	143	135 5
J W B ...	152	138	149	134	151	141	151	148	150	150
D W. L	150	150	164	157	159	162	156	157	155 5	159
S M	140 5	139	136	129	135	146	135 5	134	138	140

horizontal dimension Plot the individual records in light lines, and the average score made at each measurement in a heavy line Draw conclusions as to the value of this test

The Influence of Overtime —A member of an office staff was measured for fatigue each morning and evening for eleven days The test was the time, in seconds and fractions of a second, it took him to select one of six keys and depress it, closing an electric circuit, after a letter had been

exposed to view The record made during the test period is given in the tabulation below. The usual working hours of this man were from 8 30 A M. to 5 30 P.M , with an interval for luncheon, but on Thursday and Friday, the 4th and 5th, and on Thursday the 11th, he worked until 10 P M , and on Friday the 12th, he worked until 8 P.M. Make a large-scale graph of this record, using time as the horizontal dimension, and plotting reaction time from the top line of the chart downward, so that the slowing up of reaction will show as a dip in the record line Indicate what value this test seems to have as a measure of fatigue.

TIME	MON NOV 1	TU NOV 2	WED NOV 3	TH NOV 4	FRI NOV 5	MON NOV 8	TU. NOV 9	WED NOV 10	TH NOV 11	FRI. NOV 12	SAT. NOV 13
Morning . .	1 40	1 42	1 35	1 44	1 32	1 52	1 52	1 22	1 44	1 50	1 35
Evening .	1 16	1 58	1 35	1 63	1 69	1 63	1 42	1 45	1 61	1 76	1 30

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4 Employment of Women, 1916 (Cd. 8185)..	June, 1916	223
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CHAPTER XVII

EMPLOYMENT MANAGEMENT

"Problems in human engineering will receive during the coming years the same genius and attention which the nineteenth century gave to the more material forms of engineering," says Thomas A. Edison. "We have laid good foundations for industrial prosperity. Now we want to assure the happiness and growth of the workers through vocational education and vocational guidance and wisely managed employment departments A great field for industrial experimentation and statesmanship is opening"

At one time the problems of labor appeared to be largely a matter of the policies of organized labor, and the methods of industrial warfare. These problems now are seen to have their origin in the daily relationships of employer and employee; and to require for their solution, chiefly, knowledge and justice in selecting men for their work, in adequate training, in the fixing of wage rates, in the maintenance of proper working conditions, in the protection of workers from disease and accidents, in the provision of means by which the worker's desires may be given consideration, and in the extension of a helping hand to lift the worker out of a narrow and inadequate life.

Hitherto, executive control in business has had three main branches: finance, manufacturing, and sales. The management of the labor force has been a mere secondary function of the foreman. There has now developed a fourth major subdivision of management, namely, the supervision of personnel or employment management.

Functions of the Employment Manager.—The primary functions of an employment manager are to hire shop employees (and often office employees also), to superintend transfers and promotions and discharges, to assist in determining rates of pay, to

study the causes of labor turnover and absenteeism and strive to reduce them, and to adjust grievances.

In performing these functions the employment manager will need to organize a staff and provide himself with proper office aids. He will require a set of labor records, which will reveal for each department of the business the degree of efficiency being attained in the utilization of labor. He will analyze the sources of labor supply, and make studies upon which job specifications, which set forth the qualifications required for each task, can be based. He will install such methods of physical and mental examination as will safeguard the force against the hazards of the occupation and the hazard of co-employment with men unfitted for their work.

The process of wage setting has now so greatly developed that there is need of expert service to determine base rates, to work out equalization scales, and to devise whatever may be needed in the way of efficiency rewards, bonus systems, etc

To the employment manager often falls the function of supervising the training of employees by apprenticeship, in vestibule or shop schools, or by Americanization programs.

The employment manager should be the chief agency of his corporation in forming and executing the policies which may be adopted for keeping the worker up to the standard. These efforts may take any one of a variety of forms. In one case a restaurant may be opened, in another housing may be provided In one plant a mutual benefit organization may be a success, elsewhere local transportation may be a serious problem, or a recreational or thrift campaign may occupy the most attention. Each industrial situation requires particular study. The prescription of economic and social remedies should rest as strictly upon diagnosis as does prescription in medical practice. This means that the employment manager should know how to make industrial and labor surveys.

Finally, in connection with the government of the shop, the employment manager will have a hand in drawing up shop rules, and will, by means of suggestion systems and control sheets, deduce the significance of complaints and the causes of discharge and quits. He will be in contact with shop committees, should such be formed. And he will be a harmonizer and mutual inter-

preter in all collective bargaining negotiations with organizations of employees.

It will be observed that these functions are not new in industry. They are now being gathered together under one authority so that they may be handled in a more expert manner, that they may be harmonized into a consistent policy, and that they may be made the definite responsibility of competent officers.

In such a summary of possible activities as the foregoing, the range of duties indicated is wider than would probably be undertaken in most individual cases. Nevertheless, the employment manager has need of a firm grasp on the technique of his art, and an acquaintance with the successful policies of other employers.

The Employment Manager and the Foreman.—From the shoulders of the overloaded superintendent there have slipped down upon the foremen of the shops a mass of heterogeneous functions. In establishments where the modern plan of functionalizing and service departments is unknown, each foreman is for his own shop a Jack-of-all-trades, endeavoring to deal directly with the details of a great variety of duties. The inefficiency of such methods has been amply revealed by the analyses of the exponents of scientific management.

The remedy is specialization. This means that groups of related duties are put in the charge of service departments such as the stock room, the repair department, the planning room, and the tool room. From the foreman's point of view the employment manager is such another functionalized executive introduced to operate a service department.

By this development the foreman is relieved of importunities to hire the friends of the employees of his department on the basis of friendship rather than fitness. He can no longer sell jobs, nor hold his favorites in soft assignments. He is deprived of the easy device of covering his own incompetence by firing a man. He can ask for the transfer of unsatisfactory employees, but if enough of these transfers show that discarded persons are able to make good in another shop, where the formanizing is different, he prepares a prima facie case against himself. The foreman gets a more even and dependable run of workmen from the employment department than he can provide for himself. And he is

freed from many distractions to become an expert in shop manufacturing processes.

The Labor Market.—The casual applicant for labor, who goes the rounds of employment offices, or stands at dock or factory entrances, is the victim of a wasteful, fatiguing, and discouraging system which, for all its cost to him, affords the employer but an indiscriminate and unreliable source of labor supply. The judicious employment manager will free himself from dependence upon this supply by building up a reserve list of approved applicants, who have been interviewed, and whose references have been investigated.

The most important source of labor supply for firms which have earned the good will of their own employees is the applicants recommended by those employees A fair employer can usually meet requirements by posting notices through the plant, describing the positions to be filled, or by distributing application blanks to such employees as are willing to make recommendations.

Advertising in the want columns of the newspapers, and drawing upon the "positions wanted" insertions, is a practice sometimes criticized; but it is an important supplement to all other sources of supply. Newspaper advertisements are unequaled for obtaining young workers who know of no way of obtaining positions other than to answer advertisements and peddle their services. The method is indiscriminate, and candidates need careful culling, but this fault can be partly remedied by stating in detail the requirements and conditions of the work.

Few employers use private employment agencies. Such agencies are usually superficial in their investigations; and not a few of them are dishonest. The prejudice which exists against them limits the work of the class largely to the business of placing "floaters" with firms which are always having labor troubles.

Public employment bureaus, although efficient in a few states, have not developed a comprehensive system. They serve chiefly as a clearing house for unskilled labor. They are in a position to do a valuable piece of work with reference to short jobs. Under usual conditions, in cities of any size, there are too many men attempting to live on short jobs. Each of these persons gets a job now and then; but the class as a whole is miserable, and but

intermittently employed. The Wisconsin plan is to select from the casual labor class a group of men fitted for miscellaneous unskilled work, and not more numerous than can be kept continuously employed. The men of this group are carefully scheduled from one job to another. By turning others away from this class of work entirely, the extra supply of men is gradually disposed of in permanent positions, or is distributed to other localities. When such a program is being followed by the public agencies in any locality, the employers of floating labor should cooperate by dismissing the lines of waiting men at their gates, and by taking casual laborers from the selected list only.

Employment agencies maintained by associations of employers are looked upon by labor with suspicion as probable strike-breaking agencies.

Application and Interview.—After the labor market has yielded a prospective candidate for employment, the employment department takes its second step in selection by such a personal "sizing-up" process, and by such interrogations, written and oral, as will give some clue as to whether or not the candidate can satisfactorily fill the position which is vacant. The process involves an interview, a written application filled out by the candidate, and the investigation of references.

The interview should not be hurried, and should be sufficient in length to put the candidate at his ease, to show him in his natural state, to induce him to reveal himself by talking of himself and his previous employment, and to permit judging the candidate carefully and fairly on the basis of his expression of himself rather than on the testimony of others. It must be remembered that the candidate is likely to be excited and confused, and that he will almost certainly carry away a confused recollection of what was said to him. For this reason the interviewer should make any statements, which might be interpreted as promises, very clearly and simply and with adequate repetition. Such statements should be repeated at a later time, to insure a correct recollection of them. For this purpose, and also to obtain a fresh impression of the candidate, a second interview should be arranged, after a little interval, before going further with the process of employment.

As to the showing made by the candidate, it may be said that

attention should be chiefly centered upon what is least likely to be fixed up for the occasion. General appearance, manner, and expression can be less easily " doctored up " than the substance of what is said. The interviewer should be familiar with the rule, well established by psychologists, that persons high in intelligence tend to underestimate their own ability, while those of low intelligence usually overestimate themselves. Another useful rule of psychology is that one's capacities tend to be the same as one's interests.

Claims to the possession of trade skill must be accepted tentatively only. The results of trade tests given to 250,000 American soldiers in 1918 and 1919, claiming trade ability, revealed the fact that 6 per cent were experts, 24 per cent journeymen, 40 per cent were apprentices, and 30 per cent novices

" Experiments indicate," says Dr. Frankel, " that ordinary methods of interviewing are thoroughly unreliable. Professor Scott tells of an experiment made by the American Tobacco Company. Six managers of sales divisions in different parts of the country came together to select 18 salesmen from 36 applicants. Each manager interviewed and selected his men independently and by his own method. In the case of 28 applicants there was not even agreement as to whether they belonged in the upper or lower half of the group of 36. One was rated as number 1 and 32, another as 3 and 30." [1]

In considering references, the inference which lies on the surface has to do with the known ability of the firms given as employers. Either the candidate has been good enough to hold positions with well-known and efficient firms, or else he has shifted around amongst the most careless employers of the locality, or else his history lies somewhere between these extremes. The open letter of recommendation need not be considered; careful employers no longer issue such documents.

Of the average application blank which is filled out by the applicant, as his first step in applying for work, Dr. Frankel says: " At the present time the application blank reflects the absence of the job specification and a careful analysis of the work requirements. There is remarkably little differentiation."

[1] Hiring and Firing, Lee K Frankel, N. Y Metropolitan Life Insurance Company, 1918, p. 30.

Physical Examination.—If, as a result of the filing of an application, and obtaining interviews with a representative of the employment department, and with the foreman or superintendent to whom he will be assigned, the candidate is accepted, the next step in the employing process is to refer him to a physician for physical examination. This may be under the supervision of a company doctor or of some outside agency. In the best practice this examination is as thorough as that given for life insurance.

The general physical type of the candidate is to be observed, and his color, weight, height, age, muscular development, and deformities noted. The eyesight will be measured. If there is vision in but one eye the worker must be kept from all eye hazards. The acuity of hearing will be measured. The nose will be examined for obstructions, coryza, rhinitis, and ulcerations. If the candidate is a mouth breather, he must be placed where there is little dust. The mouth, throat, and neck will be reviewed to determine the condition of the teeth, and to note any evidences of throat diseases or glandular disturbances. Tonsillitis is not only a contagious disease, but is associated with rheumatism and heart disease.

The chest will be examined for heart diseases and for tuberculosis, pleurisy, bronchitis, and asthma. The pulse and the condition of the arteries will be given attention, especially to determine blood pressure and evidences of arteriosclerosis. If a candidate with high blood pressure be put upon heavy work he may suffer a cerebral hemorrhage, and be wholly or partly incapacitated for the remainder of his life. The abdominal region will be given attention for evidences of gastritis, chronic appendicitis, and to determine the condition of the liver, spleen, and kidneys.

In the inguinal region careful examination will determine if there is evidence of hernia. This is one of the most frequent of disabilities. Preliminary symptoms will warn the surgeon that the candidate must be kept from all operations involving severe lifting strains. The genito-urinary region will be studied for dropsical or tumorous conditions and for evidences of active venereal disease. If there is curvature of the spine, or if the extremities show signs of fractures, mutilations, and varicose veins, or are missing, the facts will be noted. Especially will examination be made for flatfoot and for stiff joints. Flatfoot

is one of the great causes of excessive fatigue in individual cases, and should be accommodated by work which can be done in a sitting position. The skin will be examined for eczema, herpes, scabies, dermatitis, etc. If indications warrant it, there will be supplementary laboratory diagnoses of the blood, the sputum, or the urine.

Upon the conclusion of an examination, the findings are communicated to the candidate: and he will be given advice as to the occupations which are safe for him, and as to the steps which should be taken to protect his health. If he is accepted for employment, but his physical condition warrants it, he will be put under a course of treatment, kept under medical supervision, and reexamined from time to time.

The results of medical examinations, such as have been given in recent years to large bodies of men, have come as a distinct shock to the public mind, because of the defective condition in which a very large proportion of the population is found to be. The United States Army tests, given to 2,500,000 men, revealed 468 defects per 1000 men. It was found that per 1000 men 124 had weak feet, 10 had hernia, and 30 had tuberculosis. At the Clothcraft Shops, in Cleveland, Ohio, it was found that but 15 per cent of those examined had teeth in good condition. At the Cambria Steel Company, the examination of 12,302 persons revealed eye defects in 10 per cent of the cases, seriously decayed teeth in 15 per cent, deformities in 10 per cent, and open canals or symptoms of hernia in 16 per cent. At the Eastman Kodak Company, in Rochester, N. Y., the examination of 6000 persons showed that 25 per cent had serious conditions of the teeth, $2\frac{1}{2}$ per cent had serious hernia, and 1 per cent had dangerously high blood pressure.

Rejections, as the result of physical tests, vary with the arduousness of the work in view, the physical excellence of the local population, and the strictness of the employing authorities. The Norton companies of Worcester, Mass., in 2618 examinations rejected 3.1 per cent, about one-half for eye defects and one-half for hernia. The Sears, Roebuck Company of Chicago, out of 7000 applicants, rejected but 3.1 per cent, although 18 9 per cent had to be confined to carefully selected positions. The Hood Rubber Co., of Cambridge, Mass., on the basis of 12,916 exami-

nations and reexaminations, found 3.6 per cent unfit for any employment with them, and 7 per cent fit for special employments only.

The Norton Company and the Norton Grinding Company of Worcester, Mass, reject applicants for the following causes:

1 All over 45 years of age

2. All men having only one eye This is because the work about grinding wheels is particularly hazardous to the eyes, even when goggles are worn.

3 All men having vision reduced to $\frac{1}{2}$ in both eyes.

4 All cases of contagious diseases, including, of course, tuberculosis

5 All cases having more than a second degree hernia

6 All cases of heart disease with disturbed compensation

7 All cases of varicose ulcer

8 All cases of fourth and fifth degree flatfoot, where the arches apparently give trouble.

9 Marked hypertension

The objects of physical examination are compactly stated by Dr. Irving Clark, of the Norton Companies, as follows.

" Benefits to the employee are

1 It gives the employee a knowledge of his exact physical condition

2 The doctor's advice enables him to remedy any defects found at this time.

3 At the time of the examination the doctor gives the applicant a little talk upon general health matters and tells him of the presence of a hospital in the plant

4 All workers found with serious defects are reexamined periodically, which enables the employee to cooperate intelligently in the case of his defect

5. Through the placement of defective employees, many men who otherwise would break down physically in a short time are given work at which they can continue for a long period of time under the doctor's supervision and advice

6 The recognition of certain defects by an employee makes him less liable to accident Thus a man having sight in only one eye, who does not realize it, is more liable to accident than when he knows that one eye is lacking in sight.

Benefits to the employer are:

1 Men physically fitted are put on the proper job. This tends to reduce the labor turnover for physical reasons, promotes contentment and diminution of lost time.

2 It makes it possible to eliminate applicants for positions who are totally unfitted for any type of work in the factory, and who if they undertook this work would be soon forced to stop, or who would injure themselves at their work, or be injured by it.

3 Prevents contagious disease from entering the factory and becoming established there."[1]

The employer is benefited further by the fact that he is protected against claims for compensation on account of accidents due to defects of vision or hearing, or fits, or dizzy spells, or hemorrhages, or stiff joints. He obtains also the good-will of the operative force. To the employee, modern medical supervision, of first-class standard, is one of the greatest boons that can be conferred.

There was, for a time, opposition to physical examinations from labor organizations. This has now, however, largely disappeared.

Mental Tests.—The next step in the employing process, logically, after the physical examination, is such an examination of the candidate's intelligence and characteristics of personality as will enable the employer to place him with reference to his mental health as appropriately as the physical examination makes possible his placement with respect to physical health. This step is, however, still usually lacking in employment practice. The means are at hand for making a fairly accurate test of general intelligence and mental alertness. Adolescents have been successfully measured for years in the schools with the Binet-Simon scale, and such improvements upon it as the Stanford Revision and the Yerkes-Bridges point scale. The intelligence test should not take the place of other means of estimating abilities. It does not measure loyalty, perseverance, and various emotional characteristics. But it does measure what is perhaps the most important single factor in efficiency, apart from physical fitness.

There is a large class of casual laborers and short job men who are wanderers and drifters because they are unable to master a

[1] Advantages of Examinations, Irving Clark, New York Times, Sept. 28, 1919.

craft or to submit to the routine and discipline of social forms of production for any length of time. The members of this fringe of the labor world beset employment offices, are constantly passing in and out of employment, and are responsible for a large part of the labor turnover. Highly suggestible, these unpenetrating minds are the willing followers after every trouble-maker and, like the carriers of communicable diseases, they help to spread disaffection and antagonism through the ranks of industry. They are in poor physical condition as a result of poorly regulated life. With little foresight, deficient in perseverance, defective in judgment, poor in comprehension, unstable in attention, neglectful and irritable, they are quick to reveal their irresponsibility by quitting their tasks at the slightest provocation.

These persons, whose numbers have been greatly increased from our immigration, are unsuited for modern forms of associated production. They have been dealt with, at enormous cost, after the ordinary methods of hiring and firing. Such methods are as inadequate for them as would be the policy of putting sick and crippled men, without physical tests, at full-strength tasks. What is needed is a method of detecting applicants for employment who are below par mentally, so that special tasks can be designed or reserved for them, and special methods of supervision devised.

It will be a great help to the employment manager, in conducting interviews and in drawing up job specifications, if he will familiarize himself with the material of some of the better-known mental tests. In the Stanford revision of the Binet-Simon rating scale,[1] his interest will probably center on the test material used for persons 12 years, 14 years, and 16 years (average adult) of mental age. The employment manager can use the rating scales to get a clearer conception of the several levels of mental ability which mark the minimum talent required for success in the various leading classes of positions he has to fill.

In the mental testing carried on in the United States Army the Alpha test was given to literates and the Beta was given to illiterates.

In October, 1919, the Alpha test was administered to 5950 students (both men and women) of the Ohio State University

[1] The Measurement of Intelligence, Lewis M. Terman, Boston, 1916 Houghton.

at Columbus, Ohio, by the Department of Psychology of the University. It is interesting to compare the percentage classification of college students with that of enlisted men in the U. S. Army. The figures are as follows:

	Class	U. S Army	O S U. Students
A	Very superior	4– 5 per cent	51 56 per cent
B	Superior	8–10 per cent	. 32 79 per cent
C+	High average	. 15–18 per cent	.13 12 per cent
C	Average	25 per cent	. 2 32 per cent
C−	Low average	20 per cent	. .20 per cent
D	Inferior	. 15 per cent	. . .00 per cent
D−E	Very inferior	7–13 per cent	.00 per cent

Considering the classifications D, D−, and E, which comprise from 22 to 28 per cent of the forces, we find descriptions given as follows:

"D men are likely to be fair soldiers, but are usually slow in learning and rarely go above the rank of private. They are short on initiative and so require more than the usual amount of supervision. Many of them are illiterate or foreign.

"D− men are very inferior in intelligence, but are considered fit for regular service. E men are of a mental inferiority which justifies their recommendation for Development Battalion, special service organization, rejection, or discharge D− men are of such inferior mentality that they are rarely able to go beyond the third or fourth grades of the elementary school, however long they attend. In fact, most D− and E men are below the 'mental age' of 10 years and at best are on the borderline of mental deficiency. Most of them are of the 'moron' grade of feeble-mindedness. D and D− men are rarely suited for tasks which require special skill, resourcefulness or sustained alertness. It is also unsafe to expect D, D−, or E men to read or understand written directions." [1]

Trade Tests.—The greatest achievement of the Committee on

[1] The Personnel System of the United States Army, Washington, D C., 1919 Government Printing Office, Vol II, pp 223–231. The test material for Group Alpha, and the instructions have been issued by the War Department. They may be found in, Army Mental Tests, Clarence S Yoakum and Robert M Yerkes, N. Y, 1920 Henry Hall and Co

Classification of Personnel in the Army, during the World War, was the preparation of over eighty trade tests, by means of which the men of the drafted force were rapidly and accurately classified according to trade, and in each trade were ranked as experts, journeymen, apprentices or novices. A novice is one with no trade ability whatever. An apprentice is one who has acquired some elements of the trade, but is not sufficiently skilled to be entrusted with any important task. A journeyman is qualified to perform almost any work done by members of the trade. An expert can perform quickly and with superior skill any work done by men in the trade.

These tests appear to be very simple: they are, in fact, the result of extremely thorough methods of construction, revision, selection, and proof. The first step in the formation of a trade test is to gather full information as to the essential processes and equipment, from employers, expert workmen, trade literature, labor unions, trade schools, etc. From this information a list of from 40 to 60 tentative questions is formulated. From this list all questions are eliminated which are not in the language of the trade, which are not in themselves complete units requiring no explanation, which can be answered by a chance yes or no, which are too long or which require long answers, or which are in any degree ambiguous. The remaining questions are formed into a test and tried out on a few craftsmen of different degrees of trade ability. This preliminary use of the test shows whether or not it is applicable, whether it represents good practice or not, whether or not it represents the whole range of the trade from novice to expert, and whether or not it is a representative sampling of the whole range of trade processes.

After revision, the test is tried upon 80 men, each of whom has been carefully graded by his employer, so that the group is composed of 20 novices, 20 apprentices, 20 journeymen, and 20 experts. The results of these tests are recorded and later examined statistically by experts. No question is retained which has not classifying power. Some questions will differentiate all groups on the basis of ability; others will distinguish apprentices from novices; still others can be answered by journeymen and not by apprentices and so on.

Three kinds of tests were prepared by the Committee on

Classification of Personnel: oral tests, picture tests, and performance tests. Some trades are mainly matters of skill, such as truck driving or typewriting For them performance tests are better than oral tests. Other trades, such as interior wiring or power plant operation, are mainly matters of knowledge. For them oral and picture tests are best. We choose for illustration the oral test for the Carpenter : Cabinet Maker.

C. C. P. Trade Test

Carpenter: Cabinet Maker

8-cb *Oral*

The examiner must be thoroughly familiar with the manual, "Instructions for Giving Oral Trade Tests," before using this test

1. Q *How can a bruise in a piece of wood be raised?*
A. (1) Wet.. . .. ... Score 4
(2) Hot iron on damp cloth...... Score 4

2. Q. *What is used to close the pores of open-grained wood before finishing?*
A. Filler.. .... Score 4

3. Q. *How can a bevel be cut with a circular saw?*
A (1) Tilting (setting) table (top). Score 4
(2) Gauge (guide)... . . Score 4

4. Q *With what do you set the cut of the blade on a metal smoothing plane?*
A. Screw. .. . . Score 4

5. Q. *With what kind of a joint is a table leg fastened to the rail of the table?*
A. (1) Mortise (tenon)........ . Score 4
(2) Dowel....... . . Score 4

6 Q. *How is an oak log sawed to get the best effect of the grain?*
A Quartered . ... Score 4

7 Q *What is the name of the largest plane commonly used?*
A. Joint (fore)... . . . . Score 4

8. Q. *What does the number of a saw mean?*
A Number of teeth to the inch.. . Score 4

9. Q. *What hand-saw would you use to cut a round piece out of a board?*
A Compass (Key-hole) .. ... Score 4

10 Q. *What is done to the surface of the veneer and core before gluing to make the glue stick?*
A. Roughened (scratched) tooth-planed ... Score 4

11. Q. *What is fastened across the width of the board to keep it from warping?*

A Batten (cleat). . . . . Score 4

12 Q *What plane do you use to plane the end of a small board across the grain?*

A Block (butt) . . . Score 4

13 Q *How is veneer $\frac{1}{4}$ of an inch thick treated before gluing?*

A Heated (steamed) . Score 4

14 Q *What is meant by shakes in wood?*

A Cracks (splints) (checks) Score 4

15 Q. *What are two kinds of joints used for the front of a drawer in fine cabinet work?*

A (*a*) Dovetail .. . .. Score 4

(*b*) Rabbit (lap) (tongue and groove) . Score 4

16 Q *Why are doors made up of panels?*

A. Allow for shrinkage (swelling) (warping) . Score 4

17 Q *What is used for roughing down varnish or shellac besides sand-paper or pumice stone?*

A Steel wool (wire hair).. . . Score 4

Rating the Candidate

Score	Rating
15 and below.. .	N
16 and 17	A−
18 to 29, inclusive	A
30 and 31 .	A+
32 and 33 .	J−
34 to 53, inclusive . .	J
54 and 55 . .	J+
56 and above .	E

There is no E− or E+ rating.[1]

Performance tests for the shop crafts involve tests of equipment, of materials, and of tools to be provided, instructions for the candidate (which are to be repeated without change in any way) and instructions to the examiner for scoring. The " Basis for scoring " is sometimes quite elaborate, including values for every type of defect, together with values for different degrees of departure from correct dimensions.

The Validity of the Oral Test.—The most important conclu-

[1] Used by permission of the Adjutant General's Office of the War Department

sions with reference to the process of trade testing, which the use of the army tests established are stated by Lieut.-Col. W. V. Bingham, who was the Executive Secretary of the Committee on Classification of Personnel, as follows:

"While these trade tests were being developed, two astonishing discoveries came to light. The first of these is the rarity, the practical nonexistence, of the exclusively motor-minded type of tradesman, the man who can do the job with his hands, but cannot tell you about it in words. In beginning the trade test development we had expected to meet numerous difficulties due to the prevalence among manual laborers of this variety of mental constitution. We expected to find that the oral type of tests would prove useful with the more verbally minded men: but we anticipated meeting many tradesmen of high proficiency and skill who could do little or nothing with these oral questions. This expectation proved to be wholly at variance with the facts.

"The other discovery, not wholly unrelated to the first, was the fact that in a majority of the trades the oral tests yielded more accurate differentiations of proficiency than did the performance tests. In other words, the journeyman and the expert differ from the apprentice not so much because they have greater manual skill and dexterity as because they excel in judgment, technical information, or trade knowledge

"Of course this is not the case in some occupations, such as truck driver or typist. Here oral tests are futile. The candidate must be given a chance to demonstrate his skill through actual performance. But in most of the trades the actual performance testing of the man on the manual job can be omitted without great loss to our knowledge of the man's proficiency. An oral test prepared in the manner already described is more effective than a performance test in separating journeymen from apprentices and experts. The obvious implication is that dexterity and manual facility in doing a job are relatively less important than knowledge of when to do it or which tools to choose. No generalization more suggestive for industrial education has emerged from our work than this, that superiority in trade proficiency resides more often in the head than in the hands."[1]

[1] Measuring a Workman's Skill, Lieut.-Col. W. V. Bingham, Bulletin of National Society for Vocational Education, No. 30, N. Y., June, 1919, pp. 14–15.

The Use of Trade Test Material in Interviewing.—Employment managers who are not ready to adopt trade testing entirely, ought at least to familiarize themselves with the distinguishing points of subject matter involved in them, and employ these points in interviews with candidates for employment. Of such interviews, based on trade test material, Lieut.-Col Bingham says: "These technical interviews will resemble oral tests in that they will consist of precisely such questions as have been found most useful in the oral trade tests. But they will not be administered with such rigor of procedure, nor will they yield a numerical rating. They will, however, serve to clarify the interviewer's opinion of the candidate's ability, and will be a convenient and very useful first aid in employment and placement." [1]

Problems

Employment on the Basis of Physical Examination.—A middle-aged man applied at the employment office of a well-managed establishment for a job The candidate was accepted, so far as the employment office was concerned, and was sent to the company doctor for examination The report received back was to the effect that, because of heart conditions, light labor only was permissible. It happened that there was but one class of work available for which the man's education and experience fitted him, and that was work of a fairly heavy character The man was therefore turned away. He was angry at being refused, after he had been partly accepted, and reported everywhere in the village that if they had not pried into these personal matters, he would have been taken on, he would have done the work all right, and no one would have known the difference

What policies governing the use of physical examinations, in conjunction with employment methods, should be adopted by an employing concern, so that no one will have just cause for complaint?

Abuse of the Employee Service Record.—The text mentions with favor the system of maintaining a broad and careful record of the employee's performance so that there is built up what might be called "a character on paper"—a character the entries in which the employee has a right to know, and to see fairly made, and, if desired, to take with him to a new employer Can the system of employee records be abused to the disadvantage of the employee? Report upon the system at one time maintained by the Lake Carrier's Association.

[1] Measuring a Workman's Skill, Lieut-Col. W. V Bingham, Bulletin of National Society for Vocational Education, No. 30, N Y., June, 1919, p 16.

References —The " Welfare Plan " of the Lake Carrier's Association, Paul F. Brissenden, *Monthly Labor Review*, Sept , 1917, pp 55–58, and Employment System of the Lake Carrier's Association, Paul F. Brissenden, Washington, 1918. Bulletin No 235 of the Bureau of Labor Statistics.

Word Definition Task.—It is suggested that a committee of 3 or 4 members of the class prepare and give a word definition test similar to that used by Professor Louis M Terman. Select an abridged dictionary, such as the Webster Collegiate Dictionary, choose pages by some rule which will give a collection of from 125 to 150 pages Select from the first few words at the top of the left-hand column of each of these pages, a word which will be a test (easy, medium, or difficult) for a college student to define. Do not include any words which it is probable that all or that none can define. When the preliminary list is compiled, select from it 100 words for the test, and arrange them in progressive order from easy to difficult Prepare simple brief definitions covering the various uses of the words, to serve as a guide in grading Administer the test to the members of the class Collect the papers (which should be marked with secret symbols, but no names, by their authors), grade the same, return the papers to the class, and give a tabulation of the results, together with the impressions of the committee. In giving credits, a point may be allowed for a word only when the definition indicates that the author of it could use the word, in the sense indicated, without embarrassment, in the presence of well-educated persons

The Vocabulary of Business Organization and Management.—Assign to a committee of 3 or 4 students a project similar to the one outlined above, but involving 100 words chosen from the vocabulary of business organization and management. A preliminary list of several hundred words may first be compiled from books on business organization and management, care being taken to fairly represent the various subtopics of business organization and management From these lists 100 words may be chosen for the test. Prepare definitions, administer the test, score, and report, as suggested above

The Trade Test.—If the cooperation of a local manufacturer can be secured, appoint a committee of two students, to prepare a trade test Care should be taken to select some trade for which there is a sufficient body of ideas or principles (beyond mere dexterous manipulations) to permit the construction of a system of questions and answers Compile information from craftsmen, foremen, company officers, by observation of processes and examination of equipment, by the compilation of trade names and expressions, by the examination of manuals on the craft and trade catalogs and the announcements of courses of trade schools, from the descriptions of occupations published by the Bureau of Labor,

and from any other available sources But do not examine the trade tests prepared (if one exists for the craft selected) by the Committee on Classification of Personnel in the Army When material has been gathered, formulate as many questions which appear to have testing quality as possible From this preliminary list, select not to exceed 20 questions for the test The questions should be carefully sorted and proportioned with the object in view of distinguishing between an expert, a journeyman, an apprentice, and a novice Submit the set for criticism to expert workmen, foremen and others, and report the final form decided upon with questions, answers, and scoring instructions complete Consult as reference on methods, The Personnel System of the U S Army, Washington, 1919 Adj Gen Office War Dept, Vol I, Sec 7, Trade Tests, including Chs 28–30 incl, and Vol II, Sec 6, Trade Tests, pp. 123–164

If an opportunity presents, and the cooperation of an employer can be secured, the test may be administered to a body of craftsmen, and the results compared with foremen's ratings

Mental Testing in the Employment Interview.—Make a study of the material of mental tests, drawing off such material, and arranging it in such a way that, in your opinion, it could be employed in an employment office, in interviewing candidates for jobs, to determine mental ability, but without the formality of anything like a set examination Give more particular attention to the test material of the Stanford revision of the Binet-Simon mental rating scale, from the age of 8 years through 16 years (average adult) For this material see, The Measurement of Intelligence, Lewis M. Terman, Boston, 1916 Houghton, and Test Material for The Measurement of Intelligence, Lewis M Terman, Boston, 1916 Houghton

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See also the references of Ch XVIII

CHAPTER XVIII

EMPLOYMENT MANAGEMENT—Continued

Job Definition.—Up to this point, in the discussion of the employment process, attention has been given to the study of the candidate. It is obvious that to match talent to task it is essential to know exactly what the position to be filled consists of. The first step toward this is to have an unambiguous name or title by which each craft and subdivision of a craft can be designated.

During the World War the Committee on Classification of Personnel in the Army could not by means of mental tests and trade tests alone meet the demands made upon it by the subdivisions of the Army for a full complement of craftsmen. The officers of divisions and regiments did not understand each other nor the Committee, because they used the trade terminology afloat in industry. To come to an intelligent comprehension as to the distribution of craft talent, the Committee on Classification of Personnel prepared a dictionary of job definitions which, under the title "Trade Specifications" was issued in 1918.

Meanwhile the United States Employment Service found itself in a similar state of confusion, in endeavoring to meet the requirements of employers and in transferring labor from one locality to another. A journeyman machinist might be asked for, when what was wanted was a machine erector or assembler or fitter, or even a jig and fixture man or a common machine hand. A mechanical draftsman might be supplied on demand and the work prove to be that of a machine designer. A carpenter would be called for on all sorts of specialized jobs, such as bridge, boat, or car carpenter work, or even to do the work of a cooper or a parquetry floor layer. A pipe fitter might be designated, and the work be either that of a pipe layer or pipe coverer or of a sprinkler system expert. Consequently the United States Employment Service, with the cooperation of the Bureau of Labor Sta-

tistics, issued in 1918 a series of handbooks designated as "Descriptions of Occupations"

The employment managers of private corporations may prevent confusion, both inside the establishment, and in dealings with the outside labor market, by using the trade definitions provided by various governmental agencies. These may be completed by the employment department so that they will cover all jobs represented in the establishment. In the preparation of job definitions a considerable step is taken toward the preparation of job analyses and job specifications.

Job Analyses.—The next step in the study of the job, after the definition has been prepared, is to prepare what amounts to a skeleton specification of the nature of the work and the general conditions to which the employee will be subject, as to pay, promotional opportunity, use of machinery, and the like. As to the characteristics of the work, such matters as posture, strength required, accuracy required, speed, responsibility entailed, and disagreeable conditions, will be noted. The duties and requirements of the task will be most easily understood if a brief description of the work is provided. The qualifications which a candidate should possess will be briefly tabulated, including such matters as sex, height, weight, muscular strength, together with experience, and trade or general education. It is important to give full information about wages,—starting rates, time to elapse before first advance, final rates, the particular wage system used, bonuses if any, fines if any, etc. If the average learning time is given, it may prevent the premature discouragement of a candidate from the idea that he is not making good as rapidly as is expected. Two very important, but usually omitted, matters are first, what have been the reasons why previous workers have left this job, second, what are the promotional possibilities in detail.

As an illustration of job analyses, a partly filled form is here reproduced See Figs. 40 and 41 on pp. 414–415 This form is much better than the average in use. It is employed by a progressive company in the neighborhood of Boston.

At the conclusion of the employing process, if a candidate has been accepted, it is well to make certain that the employee understands correctly what has been said to him with reference to introductory rate of wages, learning or probationary period, date

of first wage advance, later probable rates of wages, opportunity for promotion, etc., for if these matters are understood differently from what the employment department intends, no amount of later explanation will entirely efface the impression that there was misrepresentation If promises are made, a careful record should be kept in the employment department, and such promises should be scrupulously fulfilled.

Introduction to the Task.—After employment, the new employee should be courteously and intelligently dealt with in the matter of placement. Either at this time, or when next reporting, the employee should be shown all the plant facilities for his personal comfort, such as the lunch room, rest rooms, lockers, toilets, wash rooms, exits, fire escapes, and he should be instructed in the manner of recording his time. Some concerns arrange group talks, while others include a trip through the plant. Some one in the employee's department, preferably the foreman, should act as his sponsor, to see that he is introduced to his fellow-employees, and that he becomes comfortably adjusted to his new environment.

Transfers and Promotions.—Every employer of labor owes it to the general labor market to make an efficient effort to produce his own skilled labor, rather than to depend upon the discards of other plants, or to carry on a process of coaxing away the seasoned labor developed by others. In other words, every employer should adequately develop his inside labor resources, and plan to fill higher positions, normally, by transfer or promotion, so that, in the main, the demands made upon the outside labor market will be for beginners only. Such a policy cannot be developed to its proper extent unless the various jobs have been analyzed as to their requirements, and unless records have been developed which will show the capacities of the individuals. If this is done the natural lines of transfer and promotion will reveal themselves.

With reference to transfers, particularly, it can be said that if a firm of size is dealing with a well-intentioned employee of fair health and intelligence, and it fails to make of him a satisfactory employee, the case is to be looked upon as prima facie evidence of the failure of the management. In other words, every employer of size should have a place for all kinds of persons. Every man is

JOB SPECIFICATION

Job Name ___BLACKSMITH - ALL ROUND___ Job No. ___B 20___
Departments ______ Group No ______

DESIRABLE EMPLOYES' QUALIFICATIONS

[X] Male [ ] Female **ENGLISH** [X] Speak [X] Read [X] Write **SCHOOLING** [X] Public [ ] High [ ] Technical [ ] University

NATURE AND CONDITIONS OF WORK

[X] Floor	[X] Standing	[X] Heavy	[ ] Quick	[X] Rough	[X] Hot	[ ] Dust	[ ] Dirty
[X] Bench	[ ] Sitting	[X] Medium	[ ] Slow	[X] Close	[ ] Cold or Outside	[ ] Fumes	[ ] Greasy
[X] Machine	[ ] Stooping	[X] Light	[ ] Dangerous	[ ] Exacting	[ ] Wet or Moist	[ ] Acid	

Kindred Occupation ______
Machine Tools Operated ___See Qualification No 5___
Personal Hand Tools Required ___BLACKSMITH'S TOOLS AND MEASURING INSTRUMENTS___
Approximate time required to train an inexperienced employe to do this work ______

RATE DATA

[ ] Day work job [ ] Piece work job

Starting Rate [ ] hour [ ] day [ ] week is from ______ to ______

Day Work Rate [ ] hour [ ] day [ ] week is from (a) ______ (b) ______ (c) ______ to ______

Base Rate [ ] hour [ ] day [ ] week is ______ ______ Overtime ______

Approximate Piece Work Earnings [ ] hour [ ] day [ ] week are from ______ to ______ Bonus or Premium ______

Remarks ______

Fig 40—Observation Card (Obverse)

Job Name BLACKSMITH—ALL ROUND | Job No B-20

THE DUTIES OF THIS JOB ARE	THE NECESSARY EMPLOYEE QUALIFICATIONS TO FILL THIS JOB ARE
To do all round general blacksmithing, forging and heat treating, various kinds and sizes of production and repair jobs	(1) Must be a thoroughly experienced, practical all round blacksmith, able to draw, bend, upset, weld, and heat treat all kinds of iron and steel, including tool steel, working to samples, templates, drawings, or instructions, interpreting mechanical requirements, and figuring necessary dimensions and quantity of stock required for any job (2) Must be familiar with the various grades of steel used for tools, and steels worked for general purposes (3) Must understand shrinkage allowances, shrink fits and be able to do ordinary tool dressing and tempering using water, oil or air (4) Must understand the handling of coal, coke, fuel oil and gas furnace (5) Must be able to operate small or medium sized power hammers (6) Must be skilled in the use of the ordinary blacksmith tools and measuring instruments (7) Must be an active, careful workman, physically strong and able to endure heat (8) Must be capable of directing helpers

Remarks

FIG 41 —JOB SPECIFICATION CARD (Reverse)

good for something, and the business of the employment department is find out what that something is The proper remedy for a labor misfit is usually a transfer, and not a discharge This is the position taken by the Ford Motor Company, and by many other leading employers. The Ford Motor Company, which in 1913 discharged 8390 employees, reformed its system, and in 1915 discharged but 27 persons.

In favor of transfers it can be said that a man who is not making good on his job is better known to the employment department than when first employed, so that the probability is that he can be fitted to a second job more successfully than he was to the first Transfers stimulate the labor force much as promotions do, for they are an evidence of regard for the individual worker; and the position left vacant gives an opportunity for a stimulating series of promotions below it The transfer, of course, saves to the company the general experience and adjustment acquired by the employee

Promotions are transfers to higher pay or better work for merit, the making of them stimulates employees to earn merit. Promotions are the proper answer to the argument that an employee must not do his present work conspicuously well or he will always be held upon it. And they are a recognition of the logical claim that the opportunities within an establishment belong to those who are members of its labor family rather than to outsiders For further consideration of the subject of promotion Chapter IX on Rules of Administration should be consulted.

Regularization.—Every employment department owes it to the labor market not to pour out upon it periodically a great supply of labor, and as periodically draw in labor for temporary convenience The problem of unemployment is a constant invitation to some form of radical public initiative such as the inauguration of extensive public works, or the adoption of some form of unemployment insurance Those employers who dislike the extension of public initiative should remember that they may make a contribution toward the solution of this problem by regularizing their own establishments Conspicuous successes have already been achieved in this by establishments in some of the most seasonal industries; so that the plea that it is impossible to maintain a regular force must not be taken too seriously

The Service Record.—It is very essential that the employment department should bring together, in one place, in its records all information bearing upon the value of an employee to the company, so that this information will be at hand to make action intelligent, when promotion, demotion, transfer, or discharge is under consideration.

A progressive New England manufacturer summarizes all information concerning each employee upon the two faces of a carefully designed card $11'' \times 8\frac{1}{2}''$ in size. This condensed service record contains data classified as follows:

1. Personal data
2. Nativity and citizenship.
3. Marital state and dependents.
4. Schooling.
5. Physical rating.
6. Special experiences (Plant activities, community activities, entertainment ability, athletic ability, hobbies)
7. Previous employment record
8. Training.
9. Special ability (in answer to the question Do you think this person would make a good foreman, instructor, chief clerk, cost department, or mechanical man?)
10. Job and pay changes, with rates, dates, and reasons
11. Accident record
12. Attitudes (toward his work, the company, associates, etc)
13. Errors number and cost.
14. Suggestions made and accepted
15. Earnings, by quarters
16. Earnings, charted by weeks.
17. Absences, charted by weeks. Also mutual relief received, charted by weeks
18. Production, quantity.
19. Production, quality
20. Waste material
21. Final endorsement (This provides for a rating in a scale of 5 points on (*a*) quality of work, (*b*) productivity; (*c*) regularity of attendance, (*d*) attitude

Recommended for re-employment? Yes—No

Space for other information.

The Rating Scale.—The rating scale, which has revolutionized the entire process of expressing judgments of persons, is the work

of Colonel, now President, Walter Dill Scott. It was adopted in 1918 as the official method of recording the efficiency of all officers in the United States Army. It can be applied in industry to the rating of workmen, clerks, foremen or the higher officers of a corporation, although it has to do with qualities which are more particularly essential in the work of those who have supervision over others. The process of the scale can be used for other qualities.

The scale is thus briefly described in a publication of the Committee on Classification of Personnel in the Army: "To measure anything there must be a standard of comparison. The rating scale is a device for measuring human ability, and as its standard it takes officers who are recognized as representative of different grades of ability.

"The important qualifications of an officer are considered, and are rated, one at a time:

(1) Physical qualities
(2) Intelligence
(3) Leadership
(4) Personal qualities
(5) General value to the service

"To obtain a standard of comparison each rating officer takes five officers who represent grades from the highest to the lowest among the officers whom he knows and uses them as the measures for one of the five qualifications.

"Each qualification has its own set of five officers, and different men will probably be chosen as standards for the different qualifications. An officer chosen for one degree of excellence in one qualification may be chosen for another qualification and for a different degree of excellence in it. Thus, an officer chosen, for the highest in intelligence may be low for physical qualities.

"When the list is complete twenty-five names appear (there may be repetitions where a name is used in the scale for more than one qualification, so that the total may be less than twenty-five). To these officers all those rated are compared, and when an exact match is obtained between an officer being rated and a 'standard officer' the appropriate numerical rating is assigned. If the officer who is rated falls between two of those on the scale

he is assigned a numerical rating between those of the scale officers.

"The sum of the numbers for the five separate qualifications is the officer's total rating. For accuracy it is customary to rate the whole group of subordinates on each qualification before adding up the totals for any one of these subordinates." [1]

THE RATING SCALE CARD

I PHYSICAL QUALITIES Physique, hearing, neatness, voice, energy, endurance. Consider how he impresses his command in these respects	Highest.... 15 High.... 12 Middle.. 9 Low..... 6 Lowest.. 3
II INTELLIGENCE Accuracy, ease of learning, ability to grasp quickly the point of view of commanding officer, to issue clear and intelligent orders, to estimate a new situation, and to arrive at a sensible decision in a crisis.	Highest.... 15 High. 12 Middle . 9 Low..... 6 Lowest . 3
III. LEADERSHIP Initiative, force, self-reliance, decisiveness, tact, ability to inspire men and to command their, obedience, loyalty and cooperation.	Highest..... 15 High. .. 12 Middle.. 9 Low...... 6 Lowest . 3
IV. PERSONAL QUALITIES Industry, dependability, loyalty; readiness to shoulder responsibility for his own acts; freedom from conceit and selfishness, readiness and ability to cooperate	Highest . 15 High... 12 Middle 9 Low . 6 Lowest 3
V. GENERAL VALUE TO THE SERVICE Professional knowledge, skill and experience; success as administrator and instructor; ability to get results.	Highest . . 40 High. 32 Middle.. 24 Low 16 Lowest. 8

[1] Personnel Work in the United States Army, Washington, D C, January, 1919, p. 11.

Ratings are considered possible after a subordinate has been under observation for a week or ten days The ratings should be on whole qualities, and not on the separate attributes used in the definitions.

The judgment passed upon the scale by army officers is that it "gives a more accurate and dependable index of efficiency than any other system they have ever examined or used" [1]

Among the advantages which the scale involves is a very greatly improved precision of judgment, arising chiefly from the fact that the process of judging a person is one of direct comparison of him with other persons, rather than with a vague ideal of perfection or an equally vague abstract scale of quality. The rating process is throughout a person-to-person comparison It is concrete instead of abstract. As has been said, "A man cannot be compared with a number He can be compared only with another man." Precision of judgment is further promoted by considering one quality at a time, and keeping all other qualities, as well as the idea of the total score, out of the mind.

It is of advantage to industry to have a system of rating the more elusive qualities of character, which is to such a degree standardized that the ratings made by different persons can be compared and, if desired, averaged. By reason of their comparability, the ratings of different persons can be used as a check upon each other This possibility gives to each appraiser a feeling of answerability for what he does.

Company Rules.—Among other duties of the employment manager is a group of functions having to do with company rules. He may be expected to aid in the drafting and codification of the rules, to supervise their publication in a convenient booklet or folder or poster, to distribute copies to new employees or post them upon bulletin boards, to take whatever steps may be considered wise to make sure that new employees understand the rules, and to manage cases involving violation of rules, after they have passed through the hands of the foremen.

In a general way, the topics covered by rule books will be as follows

[1] The Personnel System in the United States Army, Washington, D C, 1919, Vol II, p 273

Hours
Pay system
Wage system
Attachment or assignment of wages
Fines
Safety rules
Absence
Tardiness
Promotion
Change of address

Fire
Supplies
Tool system
Sale of goods to employees
Suggestions
Package pass system
Visitors
Use of telephone
Care of company property

Defective work
Conduct
Termination of employment
Recommendations
Grievances
Employee organizations
Company welfare features
Health and medical aid
Restaurant

Discipline.—It requires a continuous educational campaign to bring employees to willing conformity with a set of rules dealing with such matters as the observance of safety rules, promptness and regularity in attendance, the wearing of plain, sensible clothes, etc What is necessary, with average human nature is "line upon line and precept upon precept."

It will serve to broaden the feeling of responsibility if there is in operation an employee committee system. On the relation of the shop committee system to discipline Mr. Cyrus McCormick, Jr., Works Manager of the International Harvester Company, he said: "Several years ago the average employer in big factories took away from the individual foremen the right of hiring and firing, and gave it to the employment manager. At that time it was said that that would ruin the foreman's ability to discipline his men. It didn't, and no more does employee representation, provided (and it is a big proviso) that the effort is sincere on both sides."

The causes of infractions of discipline in industrial establishments often have subtle and remote origins. Many of them trace back to home conditions, others are the pitiful and illogical protests of thwarted spirits. Hence the need of skillful employment management work, better foremanizing, and far-reaching welfare activities. Real discipline is a very large order. It is the natural attitude of sound bodies and sound minds toward sound leadership.

Termination of Employment.—As the foremen take new employees through the employment department solely, where the

best practice is followed, so, in terminating employment, the foreman does not discharge the employee, but returns him to the employment department, which may either arrange a transfer for him, or discharge him from the plant The general tendency of administrative evolution is away from all forms of arbitrary action, and in the direction of free inquiry and final justification on the basis of established fact

Whether a departure is voluntary on the part of the employee —a quit—or is a discharge, the employment department should carefully collect three statements as to the circumstances: first, that of the foreman; second, that of the employee who is leaving, third, that of an officer of the employment department who has reviewed the case and heard the testimony of both sides. From such a record there can be formed an estimate not only of the employee leaving, but of the foreman

The employment department should tabulate departures by departments, and according to cause. Such a tabulation will throw light upon the personnel policies and foremanizing methods in use It can be made the starting point of many investigations and improvements

It is very important that the employment department get advance notice of a replacement need, for only by taking time to make a careful selection from candidates is it possible to grade up the quality of the force. Notice can be had from the foreman as to his requirements; but it is difficult to get advance notice from employees who intend to leave. In a few cities employers have agreed among themselves not to hire men from each other, unless reasonable notice has been given by employees on leaving.

A discharged employee should be protected as much as possible. A discharge, even administered with the utmost diplomacy, is a blow to pride, and an experience which tends to break down courage and self-respect Fairness demands that the minimum of injury be done to one whose failure may be more than half due to some oversight or inadequacy of the employer's agents Besides, it does not pay to turn loose an enemy.

As investigation has shown the cost of adjusting an employee to his task, and an enlarged conception has been gained of the value of an employee to his company, there has come by analogy a recognition of the value of the job to the employee, and the

justice of protecting his rights in it. By degrees industry is approaching the ideal set forth by Harrington Emerson when he wrote: "It ought to be as difficult to enter the service of a great corporation as to pass an entrance examination to West Point; but once in, it ought to be a catastrophe for a man to be forced to leave, because the company provides so much that he cannot provide himself for his physical, financial, and professional welfare." [1]

Labor Turnover.—The usual method of calculating labor turnover is to find the percentage which separations, for all reasons, bear to the average number of employees on the pay roll during the period. It is most convenient to calculate turnover rates monthly. If the periods used are not of equal length it will be necessary, if comparisons between periods are to be made, to reduce the rates to terms of an annual rate. This can be done by multiplying the rate for the period by the number of periods in a year. Layoffs are usually not classed as separations, although they reduce the numbers on the pay roll. The average number of employees on the pay roll is the total of each day during the period, divided by the number of days

It is impossible to give standards as to what turnover percentages can be considered to be normal. The nature of the industry, the class of labor dealt with, the physical conditions provided, the quality of the management, and the season of the business cycle differ from case to case. A turnover of 100 per cent per annum may, perhaps, be suggested as an average record for a manufacturing establishment. There are many plants with two or three times this figure, while during the War rates were reported all the way from 350 per cent up to 1500 per cent. On the other hand, the Plimpton Press at Norwood, Mass., with a normal force of 721 employees, had in 1921 a turnover of 13½ per cent, in 1922 of 15⅓ per cent, and in 1923 14½ per cent. This may be considered an exceptionally fine record It was made possible by the careful regularization of employment throughout the year.[2]

The employment department should provide a control sheet

[1] Efficiency as a Basis for Operation and Wages, Harrington Emerson, N Y Engineering Mag Co 1912, p 58

[2] A Decade's Development in Management, H P Kendall Bulletin of the Taylor Society, Vol 9, No 2, April, 1924, p 59.

upon which a tabulation of separations and additions can be made. The control sheet should show by departments, monthly, all entrances, all exits, whether voluntary or as a result of discharge, with a full analysis of causes. Transfers and layoffs should be recorded, although they do not enter into plant turnover calculations. Supplementary to the control sheet should be special tabulations of separations by jobs and by wage rates. An accumulation of records on any one category should be made the occasion of a study of job conditions or wage rates.

If the personnel of the average manufacturing institution be classified according to length of service, it will usually be found that about a third has served for less than a year, that another third has served terms of from one to four years, and that the remaining third has served for over four years. In 1917, the Graton and Knight Manufacturing Company, with a pay roll of 1943 persons, had a service-term classification of

39.37 per cent—1 year or less,
38.24 per cent—1 year to 5 years,
22.39 per cent—5 years to over 40 years.

The Michigan Bolt and Nut Works of Detroit, in 1919, had a composition of approximately one-third employed less than a year, one-third employed from a year to 2½ years, and one-third employed from 2½ years to 53 years. The labor force of the American Cotton Oil Company of New Orleans, in 1920, was divided approximately as follows

20	per cent	–	average	term	2	months,	caused	48	per cent	of	plant	turnover
20	"	–	"	"	9	"	"	24	"	"	"	"
20	"	–	"	"	15	"	"	17	"	"	"	"
20	"	–	"	"	34	"	"	8	"	"	"	"
20	"	–	"	"	15½	years	"	2	"	"	"	"

The tabulation just given shows at once a predominant characteristic of turnover activities. It shows that they are chiefly confined to the comings and goings of a minority of the force, in particular, that element which has a short term of labor service. Someone has said that labor turnover is a small whirlpool in a large receptacle. Mr. Dudley Kennedy estimates that from 70 to 80 per cent of the turnover of a plant will be confined to those who have been employed for less than six months. Eighteen establishments of Cleveland, with an average plant turnover of

200 per cent in 1919, had a rate of annual turnover of 1199½ per cent in the force whose term of service was one week or less, and an annual turnover of 21 per cent in the force whose term of service was five years or more [1] An investigation of the records of 53 firms, by Frankel and Brissenden, showed that over 40 per cent of the turnover takes place within the first month of employment, while 61 per cent takes place within the first three months, and 74 per cent in the first six months.[2]

Turnover is larger among men than among women; it is much larger on night shifts than day shifts, and it is two or three times as large among unskilled workers as among those who are skilled.

Every new employee introduced into an establishment, and adjusted to a particular place, entails an expense over and above what the continued service of a former employee of equal efficiency would have cost Mr Magnus W Alexander has estimated the cost of replacing a laborer at $8 50, a clerical employee at $29 00, and a highly skilled mechanic at $48 00. The Dennison Manufacturing Company of South Framingham, Mass., in 1916, estimated the average cost of replacements at $50 00. The Fayette R Plumb, Inc , of Philadelphia, at about the same time arrived at the figure of $42 00, and the United States Cartridge Company at $80.00. The Milwaukee Railway and Light Company states the cost of hiring and developing a trainman to be $217 29. This high rate is probably due to the cost of street railway accidents.

Mr. M C Hobart of the Albaugh-Dover Company of Chicago, in 1918, carefully estimated the cost of a replacement, with the following results

"For advertising	$ 0 50
For hiring and clerical work	75
For instruction	5 50
For wear and tear on machinery and tools	12 00
For loss of production.	25 50
For spoiled work and mistakes	12 00
For accidents	3 00
For interest on extra equipment	50
Total	$59 75 [3]

[1] Monthly Labor Review, January, 1919, p 23

[2] American Management Review, August, 1924, Vol 13, No 8, p 15

[3] The Problem of Labor Turnover, M C Hobart American Machinist, May 16, 1918

This tabulation brings into prominence the essential factors of loss of production, destruction of equipment, and spoiled work. As to loss in production, the records of another employer show that before a new operative has reached competency on his job he will be eleven full days of output behind.

Among leading causes of labor turnover the following may be mentioned.

Lack of character and producing ability in the employee.
The endeavor to fit a candidate to a type of work unsuited to him.
Lack of physical examination when hired.
Lack of trade and mental tests when hired.
Faulty methods of training and follow-up during the critical introductory period
Poor physical conditions in the shop
Disagreeable characteristics of the individual task.
Faulty foremanizing methods.
Lack of properly equalized rates of pay.
Lack of a definite promotion prospect
Layoffs by employers who have not regularized their operations.
Local transportation and housing deficiencies

The remedies for labor turnover suggest themselves when the causes are indicated. Turnover, like absenteeism and tardiness, and high accident rates, and infractions of rules, and soldiering, and sabotage, and strikes, is a sign that all is not right in the labor relation. One symptom may relate to many causes; one cause may show itself in many effects.

Law of the Labor Contract.—Legally considered, the contract of employment must contain the same essentials as other contracts, namely, two parties competent to contract, a lawful consideration, a lawful object or subject-matter, and mutual assent or an agreement of minds. If any one of these elements is lacking the contract is void. The existence of a contract may be implied by the conduct of the parties without any direct discussion of terms, as where one labors for another with his knowledge and consent When, after the expiration of a contract, one continues to labor for another with his knowledge and consent, a new contract is thereby formed for the same period, and on the same terms as the previous one. If a contract

for employment is for more than a year it is only valid, under the Statute of Frauds, when put in writing.

Term.—If the term of a contract is not stated it may be implied, either from the custom of payment (it being reasonable to suppose that employment is to endure until the next regular pay day), or from the customary term of contracts for the like class of labor, or from the expenditures and sacrifices made by either party to carry out the conditions. If a man moves his family to a new place specifically to accept a salaried position, it may be assumed that the period in contemplation between the parties was more than a week or month. In general, however, if employment is for an indefinite period, it may be terminated by either party without notice.

Specific Enforcement.—The law will not compel the enforcement of contracts for personal services. The courts have no means of establishing a guard over a man to see that he performs his work. The remedies for non-performance are, therefore, discharge, and action for damages.

Discharge.—An employer has a right to discharge an employee for (1) willful disobedience, (2) misconduct, (3) negligence, and (4) incompetence.

Disobedience.—Not every act of disobedience is ground for discharge. If the orders of the employer are contrary to, or outside of, the terms of the contract, or are unreasonable, or impossible of execution, obedience is not required.

Misconduct.—Misconduct which injures the employer's business is ground for discharge To disclose the employer's business secrets, to foment discord among co-employees, or induce co-employees to quit the employer's service, to take bribes from subordinates, or to steal the employer's property, are some of the acts justifying discharge. Drunkenness as a habit, or on specific occasions when the employer's interests can be proved to have suffered, is sufficient cause for discharge.

Negligence.—Negligence, like misconduct, must be of such a nature as to injure the employer's business, before it becomes cause for discharge Illness for a considerable time operates, within the meaning of the law, as negligence. Absence without good cause, especially in the case of those in responsible positions, is material. For a similar reason, the delegation of duties

to another without notice to the employer, especially where the question of competence is an important one, as in the case of an architect or engineer, is not sufficient performance.

Incompetence.—An employee is responsible for any misrepresentation, express or implied, as to his skill, experience, capacity, or training In undertaking work an employee, in effect, affirms his ability to perform it. Nor can he plead ignorance of the nature of the work, at the time of entering upon the contract, if no fraud on the employer's side prevented his securing the information. If, then, the employee reveals his inability to perform the work, even though he may work with all his energy and talent, he may be discharged. If an employee accepts added duties while employed, he is bound to perform them, for he has entered into a new contract to do so. He might, lawfully, have declined to perform them, without invalidating the original contract, but having once assented to the new duties, he is bound for their proper performance.

Wrongful Discharge.—If an employee has been wrongfully discharged, and has acquiesced, he has thereby released the employer from all liability. When there is a question as to whether or not a discharge is absolute, the proper course for the employee is to tender his services until they are definitely refused, for performance, or tender of performance, is required of one party before he can require performance by the other party. When an employee has been wrongfully discharged, he is bound to seek similar employment with reasonable diligence, in the same general locality. Failing in this, or securing less remunerative employment, he can then hold his original employer liable for his wages, or for any deficit in his wages. He is, however, not bound to accept employment of a different kind.

Condonation of Offense.—An employer having once condoned an action cannot later discharge the employee for that action alone. The retention of an employee, after his services have become unsatisfactory, operates, in general, as a waiver of breach of performance, and entitles the employee to his wages or salary for the period; but it does not afford conclusive evidence that the employer has completely condoned the offense, for he has a right to take into consideration the significance of a series of offenses in determining competence. An employee once

wrongfully discharged cannot later be ordered to return to work and, failing to do so, be legally discharged for this as a breach of performance. There can be but one discharge under one contract.

Problems

Transfers.—Would you transfer to other work, at his request, an employee who says that he never will be contented in the department in which he is now working?

Would you transfer a woman employee, who is satisfactory at her present assignment, because she had requested a transfer, giving as the reason that she would like to try some other kind of work for a change?

Would you transfer a new employee from his first position, on his request, if the foreman reported that his work and attitude were not satisfactory?

If an employee is absent on account of sickness or accident, and the foreman finds that the new employee hired to take his place temporarily, is superior to him at the work, what shall be done when the regular man returns and asks for his old job again?

If an employee is transferred to a new position, for which a wage rate has never been set, on what should the rate of wages depend?

Will you formulate a set of rules which in your opinion should cover the requirements with respect to transfers?

Discipline.—What can be done with an employee, otherwise satisfactory, whose attendance is irregular, and who never gives notice of absences?

What policy or policies would you suggest as most likely to succeed in eliminating the practice of coming to work late, and of stopping work early to clean up the work place, change clothing, etc , so as to be able to make a rush for the door at the sound of the gong?

Should an employee ever be reprimanded in the shop before his or her associates for breaking a rule or committing an error?

Is it ever advisable to change employees to jobs, or to departments, they do not like, by way of punishment?

Teaching the Company Rules.—A metal-working establishment with 2000 employees, composed chiefly of intelligent handy men and skilled mechanics, published a book of shop rules, together with general suggestions to employees. It gave a copy of the book to each man New employees received copies upon being employed It has been found, however, that the men do not study the book, and so are ignorant of the rules, and have to be told them by the foremen, usually in connection with some act of ignorance or negligence. What can be suggested as

a means for making these rules thoroughly well known to the working force?

The Employment Manager and a Hasty Foreman.—In a New England plant a truckman was pushing two heavy trucks down an aisle and in doing so was forced by his exertions to zigzag from side to side It happened that two strangers were at one end of this aisle, and the foreman was at the other end watching them, as his suspicions had been aroused by some previous actions The two strangers managed to keep out of view of the foreman by stepping behind the trucker As a result the foreman became angry, developed the idea that the trucker was in collusion with the strangers, and discharged the man on the spot

The trucker immediately applied to the employment manager for reinstatement on similar work in some other department There were a number of other jobs vacant The plant was experiencing difficulty in getting sufficient labor The man discharged from the department had been employed about 5 years, and was satisfactory

In this case the employment department had been in operation only a few months and its functions and methods, and the range of its power remained to be established, largely by the actions of the new employment manager Generally speaking, the foremen were suspicious of the employment department, fearing that it would undermine their power to maintain discipline, and would reduce them to clerks

What policy should the employment manager endeavor to put through, with reference to the discharged trucker, who has appealed to him?

The Elements of a Square Deal.—In "The Twelve Principles of Efficiency" (5th Ed, 1917, Ch 7, p 191), Mr Harrington Emerson, lays down nine rules, which he considers to be essential to the maintenance of the square deal to the employee Report these rules, and state what additions to them, if any, you would make, if you were responsible for the preparation of the statement of a corporation, to be published in the Book of Rules, to indicate the general policies of the corporation toward its employees

Collective Bargaining Contracts.—Secure a number of collective bargaining contracts from the files of the *Monthly Labor Review*, the Bulletins of the Series on Conciliation and Arbitration published by the Bureau of Labor Statistics, and from the national offices of trades unions Dissect these contracts carefully, and classify the materials. Report as to the essential clauses of such agreements, and as to the variations which specific conditions produce

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See also the references of Ch XVII

CHAPTER XIX

THE MEASUREMENT OF WAGE FACTORS

The wage problem is the endeavor of employers and employees to establish a ratio between money and services, and by so doing bring the value scale and the effort scale into connection with each other.

Broadly considered, wage rates are influenced by almost every general force which makes itself felt in the world of industry and commerce Great inequalities in wage rates exist without adequate reason, neither party to a wage transaction can be sure it has received justice, there is much suspicion, relationships are strained, and much energy is diverted from production to carry on a warfare both secret and outspoken.

The average employment contract might be expressed if the employer were to sum up conditions to the prospective employee somewhat as follows: "You give me your presumed ability and assumed skill, and the experience which I can only vaguely infer from the history you have given me. Enter my service and exert your influence of character, whatever it may be, among my employees. Use energy, if you are well and energetic; avoid accidents, if you are prudent; be regular, if you have developed regular habits. Submit yourself to direction and be cooperative and helpful, if you have the temperament and training for success in teamwork. For my part, I will introduce you into the unknown environment of my shops, will give you a task called by the same trade name as you use to designate your craft, but which may in fact be quite different, and will place you at work with machines and tools and equipment, the reliability and state of repair of which vary from one workplace to another. I will subject you to the rule of a boss whom I have made a tzar in his shop, and have never checked up as to the possible abuse of power. You can associate with my employees, selected as care-

lessly as yourself, in rooms the ventilation and heating of which we do not greatly trouble ourselves about. I say nothing regarding promotion, nor about the prospect of steady employment. Now, in view of all these circumstances, we agree that blank dollars and blank cents is the correct daily wage rate."

The Price of Commodities versus the Price of Labor.—How can a fair price for labor be attained, regularly and generally in industry? Let us look for a moment at the agencies of industry and commerce by which a fair price for a material commodity is brought about. The modern market, as illustrated by a completely equipped trading city, offers an opportuity for the free and varied play of supply and demand under a condition which aims at publicity of basic data, and reasonably accurate measurement and statement of each influencing factor. Any transaction between a supplier and a taker of a commodity for a given use is influenced by the position of all potential suppliers and takers of the same thing at the same time for the same use by publicity, as most perfectly expressed on the produce exchange

The price of an article for one demand is influenced by the possible price for other demands, and the price for all demands is influenced by the price of other articles which will serve these demands, through the merchants who are willing to reach markets, and perhaps develop new ones, when prices indicate merchandising profits. The price of an article in any locality is influenced by the price of it in other localities, through publicity and the presence of merchants and transporters who will ship in or out when the differentials admit of a profit. The price of an article at any given time is influenced by the price of it in the recent past, and the prospective price of the near future, through the presence of warehousing and merchandising businesses, which hold stores from past production to dump upon the market, or who will buy for storage and future sale, whenever price differentials warrant. The values thus locked up are carried by the banking industries upon the security of collateral which the warehouse industries are organized to safeguard.

The price of an article is influenced by the price of the raw materials out of which it can be made, and the price of the derivatives which can be made of it, because of the manufacturing industries which stand ready to convert from one product into the

other, when the price spread insures converting profit. The price of an article is influenced by the price of articles which can be made of like materials and with similar processes and equipment, by the readiness of manufacturers to turn from one line of production to another as relative prices dictate. The modern market accomplishes its work for commodities by permitting the equating of any given price with all other prices which are in any way related to it. Normal converting, transporting, merchandising, and storage charges thus limit the spreads of related commodity prices.

The securing of a fair price for labor is admittedly a more difficult thing than the organization of the commercial and industrial forces required to insure a fair commodity price. Labor cannot be stored. It can only to a slight degree be converted, as the worker is taught a new skill or craft. It is loath to move and cannot at will be shifted about to bring a distant market into line It is not separable from the human personality which must live and think and enjoy or suffer where the labor is being delivered Nevertheless, the formula for fair wages must be similar to that for fair commodity prices, to this degree at least, that any given transaction for the delivery of labor at a stipulated wage should be made in the light of as complete a set of definite and measurable relations to other wage contracts as possible.

Review of Wage Factors.—There are needed methods of fairly measuring and classifying wage earners which shall be something better than the popular trade terms now used, and the casual "sizing up" process depended upon. Matters conserving health and physical vigor can be determined by physical examinations. Intelligence can be rated by mental tests. Trade skill is measurable by trade tests, and time and motion studies More general characteristics can be summed up in service records such as are already coming into use.

Likewise, there are needed methods of measuring the characteristics of positions of employment offered. The task with its demands upon strength, speed, and skill can be stated, on the basis of knowledge derived from time and motion studies, fatigue studies, and the skill discriminations of trade tests. The rules upon which discipline and company policies rest can be codified and published. Working conditions can be summarized—as they

already are in some trades—by means of codes of shop standards, and shop ratings based upon the inspections of trade organizations The expression of the quality of foremanizing to be found in any individual establishment will present difficulties, but we may hope for more standardized conditions in the near future, as a result of various progressive movements involving shop management and foreman training, which are now under way.

As to the outside factors which bear upon the individual wage bargain, the relation of the wages of the individual job to the wages given by the same employer for closely related kinds of work should be definitely fixed by an equalization process The wages offered for the same work by other employers, and in other localities, should be made into intelligible guides for local use by improved market reports. The bearings of the cost of living upon any given wage can be made clear by quantity estimates, and by frequently compiled index numbers of costs.

Underlying all of these factors is the economic balancing process of society, which fixes the general value levels, through the operation of supply and demand. As the specific wage bargains which, in their totality compose the general wage situation, are made more accurate and just, the general market rates of wages will of necessity become so, for the general rates sum up the influence of all specific transactions.

Progress through Measurement.—The line of progress in wage-setting is to discover the means of giving an intelligible measurement to the various factors of the wage problem, to establish the agencies—at first chiefly within the establishments of progressive employers, but later throughout a line of trade, or upon a local market—for proceeding in wage negotiations more and more upon a basis of fact as to values, and less upon mere opinion or a trial of strength in bargaining.

To make progress toward accuracy in the solution of any complex problem, means to attain a higher degree of accuracy in the measurement of the individual factors which enter into the result. Each element reduced to clearness by so much reduces the realm of darkness. Each step taken with reference to any one factor by so much advances the conquest of science. Each step disposes of a collateral issue, or dresses away a subordinate consideration, so that the central issue of the demand and supply of labor power

in relation to managerial talent, or saving, or risk-bearing, can be more clearly seen and adjusted.

A wage based upon measurements will respond chiefly to the permanent conditions and general tendencies, and will be little disturbed by the mere strategy of bargaining. Such a wage will be relatively stable, for the variations of fundamental conditions are less than the fluctuations of opinion as to those conditions.

Upon an issue that is clear and measurable, the average man can mature an intelligent opinion, therefore public opinion, which always stands for what it understands to be justice, will make itself felt in behalf of just wages, if only science can make clear to the public what justice means. Any standardization of elements which will make it possible to take the labor problem to pieces, and decide one element of it at a time, will make for a more intelligent and forceful public opinion. It is apparent that the jealousy existing between capital and labor offers an obstruction to the progress of the scientific study of the factors involved in fixing the price of labor or in determining the efficiency of labor It is certainly to the laborer's interest to get the labor-valuing process into the hands of persons of scientific temper, and get scientific agencies applied to the calculation of wages.

Measurement of the Wage Earner.—The wage earner brings to market qualities as determined by age, sex, nationality, color, health, strength, acuity of eyesight and hearing, amputations (if any), and his general education, and trade experience, and qualities of character. He has much need of something more definite than the usual letters of recommendation, something more open to inspection than the records of the former employers, and something more explicit than the impromptu account of himself which he can give. The better the job he seeks, the longer the probationary period he must pass through, on work beneath him, before he can get back into the stride of his best work. The better he is as a workman and a man the more inadequate is the usual sizing-up process and the usual employment interview; and the more he suffers from the lack of accurate measurement at the hands of former employers, and the lack of documents which will make his rating certain in the world of work.

There are five tests of competency which are in process of introduction into American establishments. The first, in point of time,

is the test of time and motion study. Designed primarily to establish standards of output, these have served inevitably as a means of rating and sifting employees. The second is the physical examination, which was rapidly introduced after workmen's compensation laws laid upon employers the financial responsibility of all accidents. Mental tests constitute the third group. These, with the fourth group, which consists of trade tests, were developed greatly during the World War, as a means of classifying the American drafted force. The fifth type of test is in strictness a record rather than a test. It is the individual service record, or employee history, compiled by the employment management staff.

Measurement of the Task.—There is equal need of standardizing what the employer has to offer, and giving it an intelligent qualitative and quantitative statement. What will be the nature of the physical process? What skill and trade knowledge and experience and general education are required? What tools and equipments and machines must be understood? And what responsibility or nervous strain is involved?

The chief source of information as to the speed, stress and intermittency of work is in time and motion studies. The great contribution of scientific management to the wage problem lies in its development of the art of making accurate time studies upon work done in a carefully controlled working environment. By means of such studies a more definite conception as to what performance should constitute a first-class day's work has been arrived at than was possessed before. This is, indeed, the greatest single step ever taken in the direction of definiteness in wage measurement. It has fixed, well enough for practical purposes, one point in the scale of work effort.

When to the specifications of the task are added records of the individual performance of the workman, there is produced something to which the employee can refer in appeal against arbitrary discharge, or the spleen of any individual official. In case of a shut-down, a capable man has, in such records, specific proof, accurate and convincing, as to his capacity, and as to the result he can guarantee to another employer.

Measurement of Working Conditions.—There is need of accurate public knowledge of the working conditions to which any employer subjects his employees. If it could be certainly

ascertained in the case of any particular shop what the heating and ventilation and humidity conditions were, what dust and noise and fumes were to be encountered, what the provision was of windows and lights and seats and toilets, what the cleanliness, and what the fire risk, it would exert an influence upon the direction of the stream of labor, effect labor costs, and so make for efficiency and decency. Especially would such knowledge be effective if it could be conveniently summed up as by a code of shop classification, with a characteristic title to designate all shops of a given degree of excellence.

In such a rating can be included a statement of the work of the service departments, whose functions are to deal with repairs, tools, materials, instructions, planning, payroll, and employment management.

Measurement of Foremanizing.—The expression of the character of the foremanizing in any establishment will always be a difficult matter But there are at present an unusually large number of reform movements, in practical industry, which center upon or influence the foremanizing problem. The training of foremen is gradually making its way. This may be expected to establish certain semi-professional standards and develop something of a professional feeling Functional foremanizing tends likewise in the direction of professionalizing the occupation In the elaboration of the work of service departments, organized administratively as units independent of the shops, we have a distinct and powerful influence toward expertizing certain functions, and standardizing upon the best methods.

Wage Equalization.—An important circumstance in determining any individual wage rate is the wages paid in the locality for jobs which are not identical, but which are sufficiently similar in character so that comparisons of remuneration are practicable. When an employer brings into his establishment a group of employees who have the current market ideas as to proper remuneration, and who represent different crafts and skills, for which they have been paid at different rates elsewhere, and he pays at rates set in the ordinary way, it will promptly develop that there are grievances as to the rates of pay. If the employer has used the common terms designating the crafts as the basis of his wage grouping, he will find that traditional terminology makes one

word stand for a considerable number of different kinds of work. The International Harvester Company found that the persons they had designated as "carpenters" should in reality be classified as cabinetmakers, carpenters-all-'round, carpenter-joiner, carpenter-flaskmaker, carpenter-rough, carpenter's helper, and labor-on-construction. In an individual establishment, rates of pay are brought under intense scrutiny by reason of the close proximity of employees working regularly together. Active comparisons are made as to the difficulty or skill requirements of different kinds of work, as to the physical effort required in each job, as to responsibility imposed, and as to disadvantages due to heat, dampness, fumes, noise, etc.

When the pay is the same for tasks which are intrinsically different, or the pay is different for tasks intrinsically the same—and such cases are numerous in ordinary practice—a conviction of unfairness arises in the minds of employees. Unless these unjust distinctions are removed, and the wage scale is made to correspond fairly with the nature of the tasks, there will be dissatisfaction and ill will. The management will be looked upon as either incompetent or unfair; and the holders of overpaid jobs will be considered as "foremen's pets." Complaints as to pay will be numerous from those in underpaid jobs; there will be numerous requests for transfer to other work; and employees will be constantly leaving to try their luck with some other employer. Unequalized pay is one of the great causes of labor turnover. Consequently, there will be, in the case of the underpaid jobs, much green labor, and a high record of spoiled work and accidents.

With an adequate system of employment management, these conditions reveal themselves. The control sheets, which record labor turnover by jobs, will show an accumulation of records on the underpaid work. The record of complaints as to pay, and of requests for transfer will show a like distribution. The reasons for the labor turnover will be revealed in the terminal interviews with quitting employees, in the employment department. The records of spoiled work and of accidents classified by jobs, and the known difficulty of securing the labor force for certain jobs, will confirm other indications as to the locality of trouble.

The remedy is a revision of wage rates through the process

known as equalization. The first step in wage equalization is to form, out of the different jobs of the plant, a scale of skill or talent or performance, by arranging them in progressive order from lowest to highest The committee must consider, for each job, the education, physical qualities, and prior experience required Other factors are the nature of the operation, the conditions surrounding the work, the tools and machines which must be understood, and the responsibility carried. The scale of performance should have a sufficient number of steps or distinctive positions to recognize differences fairly, but it should be kept as simple as possible. The different steps should represent an equal distinction or advance in the quality of the performance It is usually possible to reduce very much the number of rates below that in use. The International Harvester Company before equalization had nearly 400 different day work jobs. These it was found possible to represent by a scale of 19 classes.

The wage portion of the equalized scale of the International Harvester Company, recognizing 19 groups of pay is as follows

Class	Maximum	Minimum	Class	Maximum	Minimum	Class	Maximum	Minimum
1	107½	100	8	150	120	15	190	160
2	120	100	9	140	130	16	200	160
3	120	110	10	150	130	17	210	170
4	125	110	11	160	130	18	220	180
5	130	110	12	160	140	19	235	195
6	130	120	13	170	140			
7	140	120	14	180	150			

A performance scale having been formed, the next step is to construct a value or wage scale to stand alongside of it The first connection to make between the two scales is the rate of pay for the lowest class of work represented. This may be used as the base rate or 100 per cent, all other kinds of work being rated in terms of the base rate When the current wage rates (which are to be superseded) are entered opposite the respective positions of the performance scale, a general idea can be formed as to the

tendency of remuneration, or the slowness or rapidity of wage advance with advance in performance Removing these old rates entirely, but proceeding in conformity with the general rate of progression shown by them, the remunerations of the ideal wage scale can be determined in such a way as to advance steadily from the bottom to the top, and avoid all over- or under-remuneration of the various jobs on the way. This will give wage quantities corresponding to the steps of the performance scale. A portion of the equalization scale of the Clothcraft Shops is here reproduced.

Wage Scale		Class	Operation Scale
Maximum	Minimum		
200	160	1	Sleeve sewing. Cutting in top pocket. Edge taping
180	144	2	Collar overcasting.
160	128	3	Stitching waist bands. Seaming
140	112	4	Making tunnel loops. Making flies.
120	96	5	Overcasting.
100	80	6	Sorting. Marking. Turning sleeves.
90	(Retainer wage.)		Apprentices.

In this scale the maximum wages were first fixed. All minimum rates are 80 per cent of maximum rates. All rates are here expressed in terms of percentages of the maximum rate for class 6.

The basic wage in this case is that for the minimum paid to unskilled labor—the minimum of class 6.

A wage and performance scale, representing the personnel of an office manager's department, expressed in the wages of 1917, is as follows:

Wage Scale	Class	Operation Scale
$75 00 a month	A	Experienced telegraph operators
$65 00 a month	B	Night janitors—54 hours per week Yard men—48 hours per week
$60 00 a month	C	Experienced stenographers assigned to central transcription division Day janitors—44 hours per week
$55 00 a month	D	Phonograph operators in central transcription division Stock clerks in supply division Elevator operators—48 hours a week
$45 00 a month	E	Telephone operators (girls) Mail room clerks (boys with high-school education eligible for promotion into other departments as junior clerks)
$40 00 a month	F	Central file clerks (girls) Multigraph operators (girls) Form typists (girls)
$35 00 a month (minimum)	G	Clerks on folding, gathering, enclosing, and mailing (girls) Messengers (girls) Matrons (women) [1]

It will be noticed that, in two of the scales here given, there is a spread provided between the maximum and minimum rates This permits the recognition of differences of individual merit within any one class

The Standard of Life.—There are a number of outside influences, which arise neither from any quality of the worker, nor from any feature of the job offered by the employer, nor yet from

[1] Job Specifications, Franklyn Meine Washington, Federal Board for Vocational Education, 1919

any factor which is represented in the current market rate of wages, which influence the judgment of the wage earner, and of the general community as well, as to the propriety or impropriety of a given wage. Chief among these outside considerations is the standard of life.

This conception is applied particularly to the judgment of the wages of the lowest class of labor, because its importance is derived from the idea that wages should not be allowed to sink below the level which is sufficient to maintain the worker in health and decency.

The chief difficulty with standard of life concepts, in general, is that there is no agreement as to what should be included in such a standard. Mr. Royal Meeker, former head of the Bureau of Labor Statistics, and the person chiefly responsible for the standards published by the Bureau, has said: "There is no such thing as an American standard of living, in the sense of a very superior standard giving all the necessaries, many of the comforts, and a goodly supply of the luxuries of life. On the contrary, we find that there are as many different standards as there are different incomes and families of different sizes." [1]

The Bureau of Labor Statistics has suggested three different standards:

(*a*) The pauper or poverty level.
(*b*) The minimum subsistence level
(*c*) The minimum of health and decency level.

It is obvious that the gist of the problem of setting any standard of life lies in determining exactly what quantities of goods and services shall be allowed to enter into it. Once the quantity budget has been decided, it is a simple matter to obtain the prices of the various articles, and determine what annual income a wage earner would require at any given time and place—assuming good habits and judicious expenditure—to realize the standard.

The Bureau of Labor Standard.—The Bureau of Labor Statistics has compiled a quantity budget representing a "health and decency" standard for a family of five persons. This is the

[1] Monthly Labor Review, July, 1919, p 13.

third, and highest, of the standards mentioned above. This budget was priced by the Bureau of Labor Statistics for Washington, D. C., for August, 1919, as costing $2262 47. The details of the budget may be examined in the Monthly Labor Review for June, 1920, pp 1–18. The changes in the cost of the standard of living budget are compiled carefully by the Bureau of Labor Statistics four times a year, for 32 cities

The Misuse of Standard of Life Calculations.—It should be understood that a standard of life budget, such as that of the Bureau of Labor Statistics, is not entirely an economic concept. It contains, at every point, allowances to make it comply with a conception of how a family should live. To enforce such a standard of life through the minimum wage would not be an aim to make supply and demand operate more accurately with reference to the class of labor involved, but partly to set aside the operation of supply and demand, and force a contribution from the economic community, for the sake of achieving a moral ideal. It may be entirely proper to enforce such an ideal by legislation, or for industry to enforce such an ideal voluntarily, by standardizing upon a sufficient minimum wage.

But what should be clearly understood is that there is an element of charity in the computation which is appropriate only when dealing with a semi-submerged class of labor. When we pass from such a class, to compute a proper wage level for more gifted labor classes, we cannot properly use a standard of life which contains an ethical allowance, as the basis of calculation. Unless this point is held in mind, one may fall into the absurdity of taking a standard with an ethical allowance, for the minimum wage, and, by multiplying the standard by the differential of a higher labor class, as represented by some equalized wage scale, arrive at an inflated calculation. Thus, if a standard of life budget of $2262.47 contains allowances of $300 for the sake of a social ideal, and we take a labor class with an equalized wage index of 200 per cent, and we multiply the standard of life budget by two, we shall have included an ethical allowance of $600 To demand of the community $600, over and above what supply and demand warrants, for a gifted class of laborers, has no justification either in ethics or economics Such a pyramiding of wage claims can be found in arguments presented to the Railway

Labor Board in 1922.[1] The only safe practice is to keep the cost of living concept strictly within the province for which it was designed, namely, to serve as an ethical judgment of wage rates of partly submerged social classes.

Wages and Index Numbers.—A considerable number of American firms use an index number of prices of commodities, as a means of moving the wages of all classes of employees, up or down to correspond with the general swing of commodity prices. This practice has no direct connection with the cost of living idea, but is a means of paying wages with a practically constant buying power.

The Wage Formula.—The direction of the modern movement is toward a more sensitive recognition of differences of output, and toward the use of specific elements of remuneration to reward specific elements of merit. If two men in a certain hour produce the same amount and quality of work, but one is regular and the other a frequent absentee, one is prompt and the other tardy, one is safe and the other an "accident fiend," one is a contributor of valuable suggestions and the other a knocker, one is a member of "the old guard" and the other a recent arrival with the history of a rolling stone, there can be no doubt but that the hour of one man's work is worth more than the hour of the other's. It is a part of a superior series of employee relations. And yet, if remuneration be on a time or quantity basis, this superiority is largely ignored. If ignored, it is discouraged. We have, therefore, the industrial movement to expand the wage formula, so that it will more distinctly recognize the various cardinal virtues of the wage-earning relation.

Bonus Plans.—The use of bonus payments, now become a widespread practice, is a step in this direction. Under the bonus plan, the basic wage is left undisturbed, and extra items of remuneration are added to it, to pay for desirable qualities or notable service which it is not desirable to recognize by a permanent advance in the pay rate. While held in the form of a separate element of pay, the amount of the reward can be in-

[1] See Docket No. 2,500, Decision 1267. Decisions of the United States Railroad Labor Board, Vol. III, 1922, p. 789, Washington. Government Printing Office

creased or decreased, or the reward suspended altogether, depending upon the record made by the employee.

Any bonus which is not an extra remuneration added to normal wages will cause an easing up of the employee's effort in some other feature of his work, to counterbalance the special effort he puts forth to get the bonus. This is true because extra effort cannot be secured without extra pay. Any bonus which is an addition to normal wages must be clearly understood by employees to be a share of a saving or extra profit produced by the bonus activity. Otherwise, the bonus is looked upon as evidence of ability to pay higher wages, and it leads to the conviction that the bonus should be added to the normal wages.

In conclusion upon bonuses, it can be said that they tend to bring the employee toward the viewpoint of management, and by so much to make his remuneration respond to his individual efforts, somewhat as it would do if he were in business for himself The bonus employee puts his energies on the activities which lead to the bonus, and tends to neglect other factors. Consequently, it is the function of management to prevent the bonus from throwing the factors of production out of balance. If a bonus is on production, the responsibility will rest upon the management to keep costs within bounds. If the bonus is on savings, the management must not let economy thwart output.

Modern Wage Formulas.—The tendency of a bonus put upon one or two of the factors which enter into production to unbalance operations, has caused some employers to pass beyond the use of a collection of specific bonuses, and deliberately construct a wage formula comprehensive enough to recognize each element which it is desired to call to the attention of employees, and flexible enough in its composition to allow to each factor a carefully considered relative weight in fixing the total of the remuneration. Such a wage formula demands that the employer know exactly what he wants from his employees, and that he have the administrative means developed for finding out promptly whether or not he gets it. This condition being fulfilled, the modern wage formula is one of the simplest, most direct, and most cogent ways of getting the performance desired.

One of the best known of the modern wage formulas is that which was developed by Mr. George D. Babcock for the H. H.

Franklin Manufacturing Company, of Syracuse, N. Y. The formula, which is a complex one, stated in strictly algebraic form, we need not reproduce.[1] The Employee's Information Book of the Company, briefly explains the rating system which controls the wages as follows: "The rating system aims to keep in a convenient form for quick reference the record of each individual from the superintendent down, including both office and factory employees, and pay them on that record. The points of this record, briefly stated, are:

1. Amount of work turned in.
2. Amount of absence and tardiness.
3. Spoiled work
4. Ability on different kinds of work
5. Years of continuous service
6. Percentage of time spent on day work and premium work.
7. Cooperation and conduct"

It may be added that "cooperation and conduct" are determined by a weighted scale of points, involving credits for cooperative acts and demerits for offenses.

An increasing use is being made of the point system. Under such a plan a certain number of points of credit is given for each desired act, and points of demerit are attached to undesirable acts. The rating of any employee is then simply the number of credit points remaining, after the demerits have been deducted. The credit ratings can be given positions on a wage scale, so that for any given number of credits there is a definite wage indicated. A point system may be used to distribute a bonus which rests upon a basic hourly wage, as in the case of the system of Cheney Brothers, or it may govern the entire wage, with no guaranteed minimum.

In the Cheney Brothers' system every job has both a maximum and a minimum hourly rate set for it. This is independent of any system of bonus or premium depending on quality or quantity of work or attendance. The men are rated for placing above the minimum on the following factors:

[1] See The Taylor System in Franklin Management, George D Babcock, N Y The Engineering Mag Co., 1917 Also The Taylor System in the Franklin Shops, George D. Babcock. Industrial Management, Vol 52, 1917, pp 534–554

	Maximum Credit
1 Length of service	20 points
2 Record of quantity and quality of product	50 "
3 Record of attendance and punctuality	20 "
4 Citizenship	10 "

This is composed as follows

(a) Taxpayer on real estate in Manchester or 5-yr residence in Manchester	2 points
(b) Citizen of the United States	2 "
(c) Voter in town of Manchester	2 "
(d) Ability to speak English	2 "
(e) Ability to read English	1 point
(f) Ability to write English	1 "

The maximum rate of pay is given in each class for 100 points. The minimum is for less than 30 points Department managers, at their descretion, can grant additional points as follows.

A. Versatility — 20 points

Ability and willingness, evidenced by actual performance at regular intervals, to do more than one kind of work

B. Conduct — 10 points

(a) Constant cooperation with the management in the improvement of processes and methods

(b) Success in originating and developing new ideas [1]

Point Systems.—Many ingenious efforts have been made to design a wage system which will pay, proportionately to their value, for the various kinds of work it is desired that an employee should perform The mechanism of such systems is usually to give credits in terms of points (subtracting points for demerits), and to calculate the remuneration at a fixed price per point earned.

As an illustration of a point system of remuneration, where the entire wage depends upon the rating, the following plan, intended primarily for salesmen, may be considered. In this case the common denominator is the value of the sale of a unit of that product which encounters the least sales resistance. If the value of such a sale be assumed to be \$0 04, the value of any cooperative or

[1] What 86 Years Have Taught Us About Selecting Labor, Horace B Cheney Monthly Labor Review, May, 1924, pp 11–12

non-cooperative act can be calculated from the number of points. The table of wage factors is as follows:

	Points, Credit	Points, Debit
"1 **Credit for selling desirable product:**		
Basis of reward one point per dollar of sale		
(*a*) Easy selling advertised product	1	
(*b*) Products offering double net profit	2	
(*c*) Products offering triple net profit	3	
(*d*) Products especially hard to sell	2	
(*e*) Products that have very high repeat qualities	2	
(*f*) Products that are being closed out	2	
2 **Credit for securing particularly desirable business.**		
(*a*) New customer who discounts bills	200	
(*b*) New customer who pays within thirty days	150	
(*c*) New customer who takes sixty days or over	100	
Half credit when order is received by mail		
One-quarter credit when order is closed by office		
Penalty for loss of customer—" six months without buying "	.	150
3 **Credit for cooperating with Credit Department:**		
(*a*) Information which results in saving account	100	
(*b*) Local investigation of new account	50	
(*c*) Valuable information regarding old account	50	
Penalty for bad debt through failure to report		100
Penalty for bad debt not due to salesman	.	50
4 **Credit for cooperating with Advertising Department:**		
(*a*) Report on dealer advertising activities	2	
(*b*) Getting dealer to use store advertising matter	10	
(*c*) Getting dealer to use dealer electrotype	10	
(*d*) Securing mailing list from dealer . .	10	
5 **Credit for cooperating with Sales Department:**		
(*a*) For every report turned in	1	
(*b*) For calls made without sales	2	

	Points, Credit	Points, Debit
(c) Information of interest to other departments	1	
6. Penalties and Rewards for Quality of Salesmanship:		
(a) Misrepresenting facts		1000
(b) Complaints from customers		500
(c) Goods returned "in addition to credit".. ..		100
(d) Falling off in sales over last year.		100 [1]

The mechanism of wage payment should not be overemphasized. It is not the best form of management to attempt to do, through the machinery of wage calculation, what should be done by the general system of organization, and through the application of energy and intelligence in management.

Problems

A Score Card for Working Conditions.—With the permission of a local manufacturer, make a study of the working conditions of employees in some one selected department. Make a series of preliminary observations, and obtain information by interview—especially with the foreman—with the object of building up a score card suitable for rating the shop, and for the purpose of determining the relative weight to be given to the different factors. The card should cover windows, illumination, heating, ventilation, humidity, noise, fire risk, layout, floors, passageways, seats, drinking water, dressing rooms, toilets, janitor service, accident hazard, payroll system, repair service, stock room service, tool room service, planning room service, foremanizing, employment management service, educational activities, rest room, lunch room, welfare features, pension system, regularity of employment, rules of discipline, shop committees, etc.

When the score card is completed rate the shop by it, and report the subordinate scores and the final score, with explanations.

An Equalized Shop Wage Scale.—If the permission of a local manufacturer can be obtained, make a study of the jobs in a selected shop, considering the working conditions, the character of the work of each job (skill and strength required, responsibility carried, etc), the relative outputs, and any other factors which, in your opinion, should have influence in determining wage rates. On this basis prepare what seems

[1] Methods of Compensating Salesmen, C. K Woodbridge. Bulletin of the Taylor Society, Vol. 16, No. 4, August, 1921, pp. 153–156

to you to be a properly equalized wage scale for these jobs, and locate each employee at his proper level in the scale The scale used may be a series of percentages, the highest or the lowest wage rate being taken as 100 per cent, and all other rates expressed as percentages of that rate

When this is completed, secure, if possible, from the company officers, data as to the wages actually paid. Report as fully as the permission to use the data will permit.

Market Rates of Wages.—If there is a public employment office in the locality, secure permission to tabulate from the records the occupations recognized, and the wage rates used for each occupation Rearrange the data to show the scale of different wage rates recognized, and to show the variety of jobs classed under each rate In your report call attention to any inadequacies which you find in this scale, or in the rates given to individual jobs.

A Comparison of Wage Factors.—Compare, section by section, the standard of life of the Bureau of Labor Statistics, which is described in the Monthly Labor Review for June, 1920, pp. 1–18, with the standard of life offered by John Mitchell, and described in his Organized Labor, Philadelphia, 1903, pp. 116–117, and the standard offered by John A. Ryan, and described in his book, A Living Wage, N. Y., 1920, pp. 100–107.

Point out any significant differences between them, and indicate the relative position the three standards occupy with reference to liberality

Wages and the Cost of Living.—Give your judgment on the following statement made by a management engineer "While it is not possible to better the standard of living of the whole mass of industrial workers by a general proportionate increase in money wage rates, or to lower their standards by a general proportionate rate decrease, and since, therefore, the cost of living as a basis of wage-rate adjustments is impotent for the mass, unsound in principle, and vicious in its operation, it is possible to give preference to one class of industrial workers or to a few classes as against the others, by increasing their wage rates and holding those of the others down This is all that wage adjustments that are made on the basis of living costs do, whether the basis of adjustment is some assumed 'living wage,' or merely relative changes in the cost of living They merely give a preference to the workers affected as against the remainder of the mass of people."

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CHAPTER XX

THE OLDER WAGE SYSTEMS

Day Wages, Piece Rates, Profit Sharing, The Halsey System, and the Rowan System

There are two problems around which wage systems revolve. The first is that of discovering what a first-class man ought to do in a day. The second is that of inducing a properly selected and trained man to put forth the energy to do such a first-class day's work Broadly speaking, the distinction between the old and the new systems of wage payment is that the old systems endeavor to solve both problems by means of the incentive contained in a system of payment; while the new systems attempt by means of such an incentive only to solve the latter problem, that is to say, the problem of getting a defined day's work done.

Either of these problems can be imposed chiefly upon the management, or upon the men, or can be divided in some approach to equality between the two. Of the older systems the day rate threw both problems chiefly upon the management. The piece-rate threw both chiefly upon the men. The Halsey and Rowan plans, which are late reforms of the old system, aim to split the responsibility and the incentive for the solution of both problems somewhat equally between management and men.

The vital distinction between old and new systems—between ancient and modern history in wage payment—is that the old systems were used without adequate knowledge on the part of either management or men as to what should constitute satisfactory performance; while the new systems operate upon the basis of a clearly defined task set by the management, the performance of which by the workman constitutes a satisfactory day's work.

THE DAY RATE

Systems of payment, in the main, pay either for time or for output. If for time, there is some conception as to proper output. If for output, there is some idea of the time which should be taken.

The oldest of the wage systems is the one which offers the workman a given sum for a fixed period of his time. The rate may be quoted as so much per hour, day, or week The limits of a given rate are, at the bottom, the point of inefficiency which brings discharge, and at the top, the point of excellence which is rewarded by promotion Within these limits, the day rate pays exclusively for the workman's time, taking no account of the

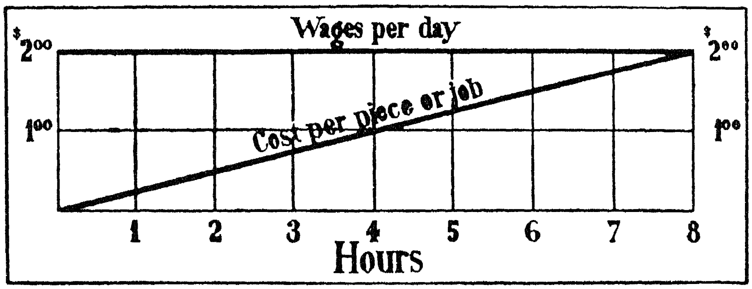

FIG 42 —WAGES AND COSTS UNDER THE DAY RATE

Wages per day Direct-labor cost per job or per piece

quality or quantity of work done So long, therefore, as the workman remains safely within the limits, he is in a passive state, except as he may be energized by the dictates of conscience, or by loyalty to his employer, or by the praise or blame of the foreman On the other hand, the employer is awakened to activity by this system of payment Any additional productive effort which he is able to secure from his force by means of the careful selection of individuals, the division of labor, the introduction of machinery, or by drive tactics of foremanizing, is clear gain to him Any slowing down of the pace creates a loss which he alone must bear.

The Chart of the Day Rate.—In designing a chart to illustrate the effect of an increase or decrease in the rate of production under the various wage systems, it is to be remembered that there are two things of primary importance. The chief stimulus which

moves the employee to exert himself is the amount of wages it is possible to earn in a day. The chief object of the employer is to lessen the direct labor costs per job or per unit of product. The series of charts here introduced illustrate for each wage system the effect of the accomplishment of the task in different lengths of time upon these two things—the total earnings of the day, and the unit cost for direct labor.

Advantages.—I. The day-wage system adjusts itself fairly well to the realities of the financial position of the employee In so far as the wage earner is content to retain the standard of life of his class, he is satisfied with wages which meet the requirements of this class standard, regardless, within considerable limits, of the energy and ability he may have to put into his work. So long as there is no question of change of class, expenses appear to be chiefly a function of time—such and such bills to be met each week or month. The wages to cover these expenses will then appear, likewise, to be chiefly a function of time—so much per day or per week.

II. The day rate favors careful work, for it permits the workman to express his ideals of craftsmanship and his pleasure in a perfect product, without loss to himself The man who builds a house by the day, instead of by the contract, never fails to mention the fact when he offers the house for sale Even excessive care as to the quality of work will not be distasteful to the day worker and his companions, for it will be recognized that this is one form of "nursing the job"

III As the day-wage plan requires less administrative attention than any other, and makes men more contented with delays and breakdowns than any others, it is suited for unstandardized conditions, for repair jobs, for building construction, and for non-repetitive work generally In short, day work falls heir to all operations which cannot be organized profitably under some better system of pay.

IV. The trade unions favor the day rate, because it creates a solidarity of interest within each wage group. Exceptional men endeavor to raise the standard wage as the only means of improving their own condition The average man is satisfied with a wage which is fair for him Those who are below the average give their ardent support to the standard, for it is a means of rewarding them beyond their desert.

V. The calculations involved in this method of paying are simple The payroll can be made up, class by class, directly from the attendance record

VI If it is desired to make day wages respond with a reasonable degree of flexibility to individual performance, it can be done by breaking up the traditional craft groups into a sufficient number of wage classes, each class being given a different rate of pay. There will thus be created a promotion and demotion scale, up and down which men may be moved according to their value

VII By dividing each kind of work into short and clear-cut tasks production may be stimulated, and even, perhaps, standardized for a time, if the performance aimed at is commensurate with the wages paid.

Disadvantages.—I. The principal objection to the day-rate system is that it represses the superior man. Mr. F. W. Taylor has said, " The effect of this system is distinctly demoralizing and leveling, even the ambitious men soon conclude that since there is no profit to them in working hard, the best thing for them to do is to work just as little as they can and still keep their position. And under these conditions the invariable tendency is to drag them all down even below the level of the medium " [1] Thus latent talent tends either to hide itself, and so not secure the necessary training and authority to render greater service, or else it finds vent in antagonistic forms of activity

II It is, of course, no argument against the day-wage system to say that it forces the best men into the unions, for the better the rank and file of the labor organizations are, the better the policies will be. But a system which produces in exceptional men a sense of personal injury is sowing dragon's teeth.

Frederick W Taylor said of the day-wage plan of recognizing no individual distinctions among the employees in a wage class, " The proper and legitimate answer to this herding of men together into classes, regardless of personal character and performance, is the formation of the labor union, and the strike, either to increase the rate of pay and improve conditions of employment, or to resist

[1] A Piece-Rate System F W Taylor, Trans of Am Soc of Mech. Eng , June 1895, Vol. 16, No 647, p 861

the lowering of wages and other encroachments on the part of employers." [1]

III. The flexibility which is to be obtained under the day-rate system by the creation of numerous wage classes (point VI above) is more theoretical than practical. Speaking from a long practical experience, Mr. H. L. Gantt says, "The employer usually pays but one rate of wages to one class of workmen, because, as a rule, he has no means of gauging the amount of work each man does. It is exceedingly difficult to keep an exact record of what each of a number of men does each day; and even if he had such records, the difficulty of comparing them would be very great, unless the work done by each man was of the same nature, and done under the same conditions. The result is that he keeps no individual records, but usually treats all workmen of a class as equals, and pays them the same wage. There may be 20 per cent who are very much more efficient than the rest, but he has no way of distinguishing them from the others with any degree of certainty; hence he declines to increase any wages, or makes the difference in wages insignificant as compared to the difference in efficiency."[2]

IV. The standardization of performance (point VII above) cannot be made self-enforcing when the day rate is used. The only *vis a tergo* to keep the men above ordinary performance is the energy and attention of the management.

"The day-work method of payment," says Benj. A. Franklin, "permits many a man to work at a task for which he has neither taste nor ability, when he might make his mark at some other. Proper incentive methods pick out the able men and often force out the unable, not infrequently into tasks at which they achieve greater success" [3]

V. Since the pace at which the management can drive the men is a variable one, the wages become an uncertain element of cost.

[1] A Piece-Rate System, Frederick W Taylor, N Y. Trans Am Society of Mechanical Engineers, 1895 Paper No 647.

[2] Work, Wages, and Profits, H L Gantt, N. Y. Engineering Mag. Co, 1910, p 52.

[3] Experiences in Efficiency, Benjamin A Franklin, N. Y. The Engineering Mag. Co, 1915, p 12

Piece Rates

The second of the long-standing plans of paying labor is to set a price upon a job or a unit of product, and pay that sum regardless (within promotion and demotion limits) of the time taken to accomplish the work. As piece rates have originated in the majority of cases in a process of changing over from day rates, it has been natural, in setting them, to take into account the previous day-wage standards, and the previous rates of performance. In most cases rates have been fixed at such a point that an average performance would yield the current wages of the trade. In some cases the rates have been based upon the idea of a "fair" or a "good honest" day's work, and the time of a single selected man, or the average time of a number of selected men, has been taken to represent this conception. There is still in this standard an indirect recognition of the current day wage, and of the prevailing pace of working. A piece rate must rest upon a judgment as to proper working times and proper daily earnings. The straight piece-work system provides, however, no regular and normal means of revising either of these judgments, and so provides no normal method of changing the rate.

Under piece work the employee makes all the gain or loss of his own time. If he shortens the time used, or if any improvement introduced by the employer shortens the time, he receives no less for the job finished, and he gains time in which to make extra earnings at the same rate. If he takes a long period, his remuneration may fall below day wages. While the employee makes all the gain or loss of his own time, the employer gains by rapid performance from the fact that the factory burden to be charged to each piece or job is decreased.

Employers favor piece rates where soldiering is difficult to detect, as in moulding; where speed is unusually important, as in railroad repair shops; where work is done away from the employer's place of business, as among the glove makers in and around Gloversville, N. Y.; and where the distinctness of tasks favors the calculation of a job price, as in the collar factories of Troy, N. Y., and the hat factories of Danbury, Conn The system is best suited for work of a repetitive nature, and for shops where there is not such constant change in the condition of jobs that the

worker is unable to make material improvements in the methods of working. In general practice, manufacturers who employ piece

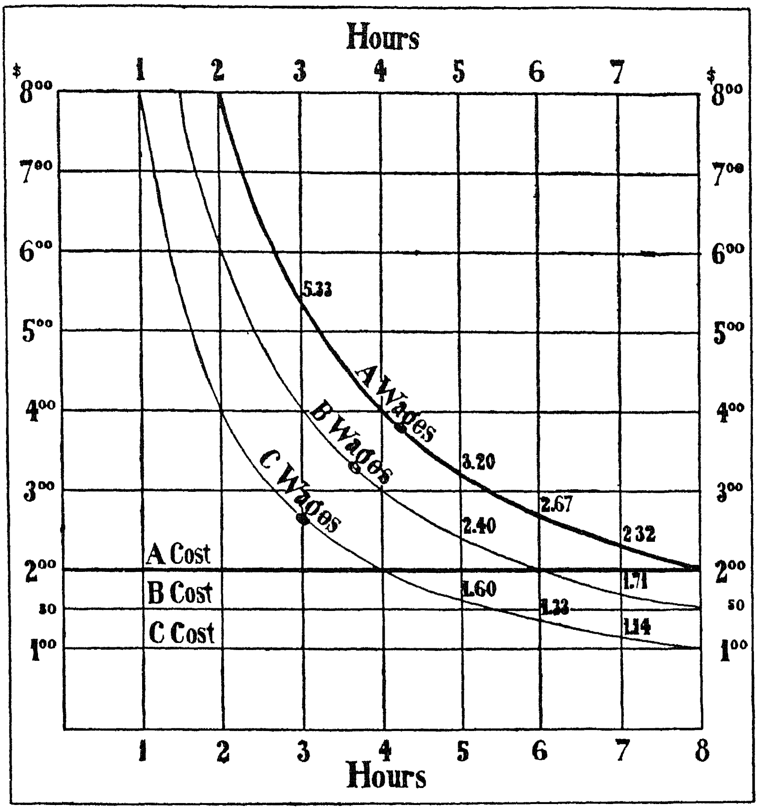

FIG 43 —WAGES AND COSTS UNDER PIECE RATES

Wages per day
Direct-labor costs per piece or job.
A = Standard time 8 hours
B = Standard time 6 hours.
C = Standard time 4 hours

rates are able to put from 60 to 85 per cent of their forces upon them.

Advantages.—I. The chief advantage of this system is that the reserve productive power of those persons capable of better

than the average performance is given a market. In contrast with the abuse and fear which "drive" systems sometimes depended upon under the day-wage plan, the introduction of piece rates developed a system of voluntary effort, creating an atmosphere of willingness and zeal for performance.

If the day-wage accommodates itself to the requirements of those employees who are satisfied with their standard of life and their status generally, the piece-rate system attracts those who are dissatisfied and wish to apply their energies to raise themselves into a higher economic class. The system thus serves as a means of sifting workers, and so performs an employment management function

II Not only is output increased, but methods are overhauled, for the thought of the worker is set loose as well as his hand. By this the workman is put under responsibility, and stimulated to take the initiative. He is aroused to demand materials free from defect. He becomes impatient with the delays of service departments, and outspoken in denunciation of breakdowns. There is thus a tendency for managerial duties to pass over from the employer to the employee, and for shop administration to drift along in the wake of the force. The workers overcome many defects of plant and management, in order to make their earnings; in short, they often "pull it through." The extra earnings made by men under the piece-rate system may, therefore, be looked upon as partly the addition of the wages of management to the wages of labor

III As this implies, total costs are reduced, for while direct labor costs remain constant at all speeds of performance, the increase in the amount of work done per hour decreases the hourly charge on account of plant and management.

IV. The direct labor cost per unit of product or per job becomes a fixed amount, reliable for use in cost calculations of a preliminary or prospective character. This is very important for all trades which "sell-then-make," such as the garment trades, and the industries dealing with style goods generally.

V The records of increased performance under piece rates constituted one of the arguments which helped to introduce the 8-hour day. To reduce the hours from 10 to 8, and maintain

output, would require an increase in the rate of production of 25 per cent. The response recorded by the Bureau of Labor[1] shows that such an increase can be attained on the average, where the inducement is offered.

Disadvantages.—I. The plan of giving to the wage earner all the saving in the time of production to be made in an establishment from and after a certain date, is bound eventually to break down and require revision. Such a revision may be forced quickly by an unexpected spurt of workmen. If they easily attain a high rate of performance, and thereby reveal how far below the best—indeed, how unworthy and absurd—was the " average " or " fair " performance used as the initial basis of calculation, the employer will believe that he has trapped himself.

II. When, under such conditions, the workmen get wages far above the customary incomes of men of equal ability, general opinion will condemn the rates as unnecessary, and as unfair.

When a workman who has been making large wages leaves a plant and a successor is put in his place, the employer feels that no part of the credit for reorganizing the work, and installing new methods, and establishing the proper rate of performance belongs to the new employee. He can hardly do otherwise than cut the rate, so that the new operative will earn but a fair rate, considering the effort to be put forth. If revision of the rate is not compelled by the workman's response, the general evolution of methods of production, including the introduction of improved machinery and superior processes of working will eventually bring it about. The employer cannot pay excessive wages for long, when the improvements which permitted them have become common property of the industry, and he must face competition. The strike of 1892, at the plants of the Carnegie Steel Company, was due to the cutting of obsolete piece rates. Before this strike was called, some of the laborers were getting larger wages than the superintendents owing to improved appliances which had greatly increased production since the rates were first set. As Mr. Halsey says, " Cutting the piece price is simply killing the goose that lays the golden egg." Nevertheless, the goose must be killed. Without it the

[1] Eleventh Special Report, Washington, D. C. U. S. Bureau of Labor, 1904, p 17.

employer will continue to pay extravagantly for his work; with it he will stifle the rising ambition of his men." [1]

III. Piece work settles down eventually into a form of economic warfare between management and men. Although the rates have to be cut, the act of cutting them is looked upon as a declaration of war. The employees consider it the violation of an agreement. The conclusion in many cases is that the management introduced the first rates as a bait to induce the men to reveal how much they could do, while the second rates constitute the springing of the trap which is designed to hold the men for the new standards of working, while not allowing wages to exceed a certain moderate excess over day wages. The response of the workman to such a policy is to oppose the introduction of piece rates, but where they are established, to soldier as much as possible while the rates are being set, in order to get a long time base, and then to control the pace so that the wages earned will never rise above the point which is thought to be the maximum the employer will allow. At that rate performance is pegged, and held, against all efforts of the management to increase it further. The piece-work system, after such a series of events, settles down into an antagonism of interest between management and men, which is as clearly defined and enduring as any contest of policy possible under day rates.

IV. The system is the parent of soldiering. Of it Frederick W Taylor said. "Even the most stupid man, after receiving two or three piece-work 'cuts' as a reward for having worked harder, resents this treatment and seeks a remedy for it in the future. Thus begins a war, generally an amicable war, but none the less a war, between the workmen and the management. The latter endeavors by every means to induce the workmen to increase the output, and the men gauge the rapidity with which they work, so as never to earn over a certain rate of wages, knowing that if they exceed this amount the piece-work price will surely be cut sooner or later. . . . Every intelligent workman realizes the importance, to his own interest, of starting on each new job as slowly as possible. . . . The extent to which, even in our largest and best managed establishments, this plan of holding back on the work—'marking time,' or 'soldiering,' as it is called—is carried on by the

[1] The Premium Plan of Paying for Labor, F A Halsey Trans. Am. Soc of Mech Eng., Vol 12 (1891), p 756

men, can scarcely be understood by one who has not worked among them. It is by no means uncommon for men to work at the rate of one-third, or even one-quarter, their maximum speed, and still preserve the appearance of working hard. And when a rate has once been fixed on such false basis it is easy for the men to nurse successfully 'a soft snap' of this sort through a term of years, earning in the meanwhile just as much wages as they think they can without having the rate cut.

"Thus arises a system of hypocrisy and deceit on the part of the men which is thoroughly demoralizing and which has led many workmen to regard their employers as their natural enemies, to be opposed in whatever they want, believing that whatever is for the interest of the management must necessarily be to their detriment. The effect of this system of piece work on the character of the men is, in many cases, so serious as to make it doubtful whether, on the whole, well managed day-work is not preferable." [1]

V. High speeds are hard on machinery and equipment, especially where the machine speeds are not scientifically set, and where the mechanical conditions are not kept under competent control.

VI. By analogy, high rates of performance are hard on the men. As was pointed out in the discussion of fatigue, high performance may be costly in human energy, unless the management possesses the ability to enforce standards conformable to the laws of fatigue. All extreme exponents are dangerous in the hands of ordinary management.

VII. The tendency of piece rates is toward volume at the expense of quality, since the wage follows the tally of pieces finished.

VIII. Straight piece work does not guarantee day wages. The discouragement of low earnings, therefore, besets the learner.

Profit Sharing

Profit sharing has been defined as, "An arrangement freely entered into, by which the employee receives a share, fixed in advance, of the profits." [2]

[1] A Piece-Rate System, Frederick W. Taylor, N Y. Trans. Am. Society of Mechanical Engineers, 1895, Paper No 647

[2] Principles of Economics, Henry R. Seager, N. Y., 1923. H. Holt and Co, p 581.

Profit sharing is not a complete system of wage payment, but an adjunct which may be added to any of the fundamental plans which do not sufficiently awaken the energies of the employees. The usual plan of profit sharing is to calculate the profits of an establishment for a fiscal period—either a year or a half-year—and to pay a fixed proportion of them to the employees in the form of a percentage added to wages. Profits may be defined, for the purpose of this distribution, as that portion of gross earnings which remains after the usual operating expenses have been deducted, and after interest on borrowed money and a reasonable remuneration on the proprietor's capital has been taken out. This sum is divided between the proprietors and the employees. The division may be into equal parts—dollar for dollar—or it may be in such a proportion as to give the same percentage of dividend on the capital and on the total sum paid out in wages during the period. The latter plan would divide the fund, in the average case, in the ratio of 4 to 1.

When the total share to be received by labor has been decided upon, the next step is to distribute it to the individual workman This individual distribution is almost always on the basis of the wages earned. It is very common, however, to exclude from participation those persons who have been employed for less than a year. The remainder of the employees may be grouped somewhat into classes, in such a way that the dividend is greatest for those of longest term of service The bonus so calculated may be paid out in cash, or it may be credited on the books of the company in payment for stock which is to be issued when fully paid, or it may be placed in a fund to provide old-age pensions or some other form of deferred benefit.

The experience of the leading profit-sharing concerns in this country seems to indicate that the plan is only successful when coupled with a stock-sharing or stock-purchasing arrangement. The Procter and Gamble Company in 1903 abandoned the cash distribution of profits to employees, and instituted a plan which makes profit sharing an element in a stock-purchasing plan.

Profit sharing does not choose as a basis for the distribution of the extra gains any measure of the individual efficiency of persons It passes by such individual records and fixes upon an item—

profits—which expresses the prosperity of the business as a whole. In so doing it aims at teamwork, and the creation of a general spirit of loyalty, rather than at exceptional individual achievements.

It is to be noticed that profit sharing involves a measure of joint risk taking. It is, therefore, distinct from any plan for distributing a bonus to employees in the form of a fixed percentage added to the wages, and given regardless of the profits earned by the employer. Profit-sharing plans naturally fade off, however, into a variety of more or less specific bonuses and gifts.

Advantages.—A steady condition of moderate industry is rather feebly promoted. Idlers who, under this system, are stealing from their fellows as well as from the management, become unpopular. In general, a willing and teachable attitude of mind comes to prevail, which produces a sound public opinion or "habit of the shop"

II. There is set up a joint aim for management and men, which emphasizes solidarity of interest. The employee is given a glimpse of the proprietor's problems, and a share in them which may somewhat modify his mental attitude.

III. The pecuniary benefits of profit sharing are indiscriminately distributed, descending, as does the rain, upon the just and unjust alike. And so the plan is suited for situations where individual contributions cannot be accurately measured. This suggests that profit sharing is a plan which ought to be more at home among salaried men than among wage earners.

Disadvantages.—I. The plan is only appropriate for established and successful businesses which can reasonably anticipate regular profits.

II. The process of calculating the profits abounds in accounting intricacies and arbitrary determinations so that, if the original spirit which inaugurated the system chances to wane, there are opportunities for disguising the earnings.

III. It is an arbitrary arrangement to couple any part of the income of the workman with the fluctuation of business conditions over which he has no personal control. Profits in a business are due, not only to the capacity of the shop employee or office clerk, but to the supply of capital, the fluctuations of the market, the advantages or disadvantages of the location, the judgment

used in extending credit, and the choice of suitable patterns and qualities of goods to make.

To distribute profits in any fixed ratio between capital stock and the total annual payroll is a wholly artificial plan, without any logical basis whatever, except that the two quantities are at hand convenient for use. After the total amount to be distributed is once fixed, the use of the payroll to determine the ratios of distribution as between individual employees is logical, for the payroll is an expression of the importance of each individual to the business.

IV. It is an axiom that speculation is unsuited for small investors. Business profits are speculative; and the profit sharer usually has not the financial reserve to enable him to average out fluctuations, and preserve his habits of consumption undisturbed. In his case income and expenditure are direct-connected, so that irregular income tends to derange the entire economic life.

V. From the point of view of the wage earner the sums to be derived from this system of remuneration, except in the cases of unusually successful corporations, are too small, too long postponed, and too little influenced by the effort of an individual to make them an effective motive with the average laborer. "The average workman," says Mr. Taylor, "in order to maintain a rapid pace, should be given the opportunity of measuring his performance against the task set him at frequent intervals. Many men are incapable of looking very far ahead, but if they see a definite opportunity of earning so many cents by working hard for so many minutes, they will avail themselves of it."[1]

VI. The dividends under profit sharing come to be looked upon as a matter of custom and as a right. If an employee in a profit-sharing corporation receives in wages $1500.00 a year, and in profits $250.00, and he has an opportunity to receive from another employer straight wages of $1750.00 a year, he will, if he remains, henceforth look upon his profits as a part of his normal wages, and not as something requiring extra effort to be put forth, nor anything to be especially thankful for.

VII. There is no new way opened by which exceptional individuals can cash in their reserve talents to their own personal advantage.

[1] Shop Management, F. W. Taylor, N. Y. Harper and Brothers, 1911, p. 84.

"No form of profit sharing," says F. W. Taylor, "has yet been devised in which each individual is allowed free scope for his personal ambition. This always has been and will remain a more powerful incentive to exertion than a desire for the general welfare. The few misplaced drones, who do the loafing and share equally in the profits with the rest, under (profit sharing) are sure to drag the better men down toward their level." [1]

VIII. In spite of the solidarity at which profit sharing aims, it is opposed by trades unions. The distinction in kinds of solidarity is elucidated by Professor Taussig: "Trade unionism looks to a horizontal division; all the employees in a trade, scattered in various establishments, are to be united in common action against all the employers. Profit sharing looks to a vertical division; the employer and employees of the single establishment are to be united, working together for the common welfare of their compact group, sharing the gains and perhaps the losses. . . . The unions are opposed to profit sharing, or at least suspicious of it, because it tends to make the workman interested chiefly in the welfare of his immediate fellow-employees, not in that of all workmen of the trade or locality." [2]

The Halsey Premium Plan

This system of wage payment is named after F. A. Halsey, being devised by him while he was Superintendent of the Rand Drill Company of Sherbrooke, Canada. The idea of it, expressed in a sentence, is to ascertain the average previous times of doing jobs, and to offer the workmen an agreed percentage of the wages of any portion of this time they may save, in addition to their regular hourly or daily rate for the time taken.

The author of the plan says of his time base, "Time is determined from previous experience." [3] In practice, the average of previous times is taken. He explains that the aim is to be liberal with the time rather than with the premium. It is usual

[1] A Piece-Rate System, Frederick W Taylor, N Y Trans. Am. Society of Mechanical Engineers, 1895, Paper No 647.

[2] Principles of Economics, F W Taussig, N. Y. Macmillan, 1911, Vol. II, pp 303–304

[3] The Premium Plan of Paying for Labor, F A. Halsey, N. Y. Am. Society of Mechanical Engineers, 1891, Vol. 12, p. 759

to guarantee that when the time limits are once set for jobs they will not be reduced, unless the method of doing the work is changed Day wages are guaranteed to those who fail to reach the standard

To workmen who finish their tasks in less than the allotted time, there is paid, in addition to the hourly wages for the time worked, a proportion of from $\frac{1}{4}$ to $\frac{1}{2}$ of the wages of the time saved Mr Halsey indicates that the 50 per cent bonus may be paid if the task is a difficult one which has been scientifically set, but that $33\frac{1}{3}$ per cent is enough when the records of past day work or piece work are used If, then, a workman who is on an hourly rate of 25 cents has an eight-hour task given to him, and completes it in six hours, and the bonus is $\frac{1}{3}$ of the saved time, he will receive—

$$\begin{aligned} 6 \times \$0\ 25 &= \$1\ 50, \text{ the hourly rate, and} \\ \tfrac{1}{3} \times \$0\ 50 &= \underline{\quad 167}, \text{ the bonus,} \\ \text{Total} &= \$1\ 667 \end{aligned}$$

which is at the rate of \$0.278 per hour, or \$2 22 per day.

The premium is calculated on each job separately, so that failure on one job does not sacrifice the premium earned on another. Shop conditions are not disturbed The acceptance of the plan is voluntary with each workman Regular wages are paid, and the bonuses earned are put in separate envelopes and placed at the disposal of any workmen who will take them. The plan differs from day wages in that workmen get extra pay for extra product, and from piece work in that the rate of pay per piece decreases as the amount finished in a given time increases.

Advantages.—I The Halsey plan is easy to introduce It requires no preliminary studies, other than to calculate previous average times, and it calls for no reorganization or new agencies other than those required to collect the times of current jobs It adjusts itself to unstandardized conditions and to the ordinary processes of administration It is suited to conditions where, because of the variety of work, scientific piece rates cannot be used A modification of the plan was used by Dwight V Merrick and Carl Barth, at the Watertown Arsenal, during a transitional period, with great success

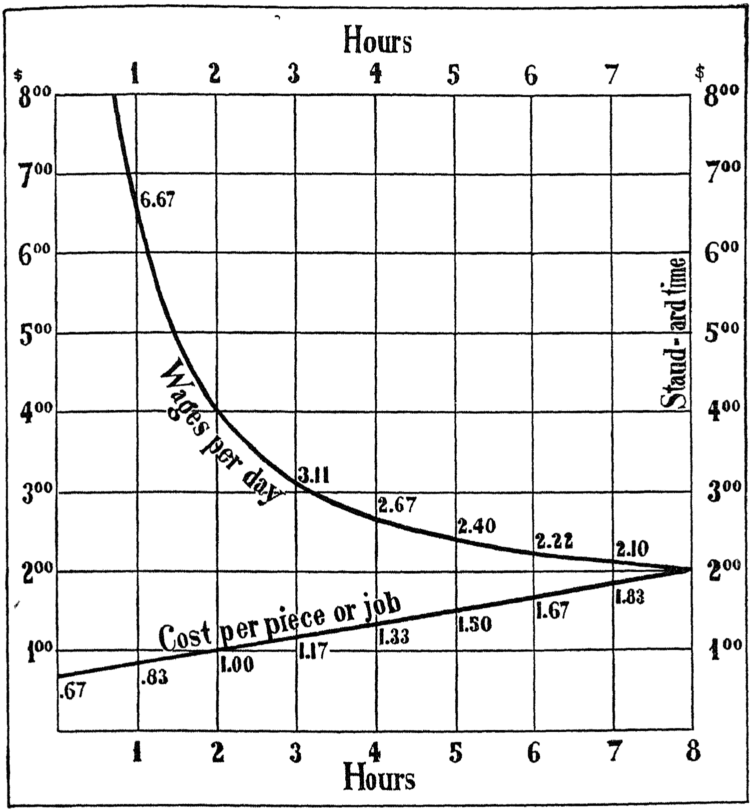

FIG. 44.—WAGES AND COSTS UNDER THE HALSEY PREMIUM PLAN [1]

Wages per day
Direct-labor costs per piece or job
Standard time 8 hours (previous average time)
Bonus one-third of saved time

[1] If the reader will draw upon this diagram the "Wages per day" line from the day rate diagram, and the "A Wages" line from the piece rate diagram, he will observe that two areas are enclosed on either side of the "Wages per day" line of the Halsey diagram The area to the left of and below the "Wages per day" line of the Halsey diagram represents that portion of the time saved by the wage earner for which he is paid The other area represents the saved time for which the management does not pay.

II A chief merit urged for the plan is that, by dividing the profit of saved time between management and men, it makes for the permanence of the bonus rate If an unduly liberal time base be fixed for a job, and if as a consequence a workman makes a great saving in time, only a portion of the saving is given to the workman an arrangement which prevents wages from being forced up to such high figures as to exhaust the patience of the employer.

III. The psychology of the plan is adroit. If an employee is able to complete in eight hours ten jobs of a standard time of one hour each, it is obviously the same thing, financially, to offer him 25 cents an hour and one-third of his saved time, as to offer him 25 cents each for the first eight jobs finished in a day, and $8\frac{1}{3}$ cents for each additional job The sound of the two propositions is, however, quite different

Disadvantages.—I The Halsey plan shares with straight piece rates the weakness of taking an unscientifically determined standard time for its jobs. It takes its time from past performance. Of this feature Taylor said. "The starting point from which the first rate is fixed is unequal and unjust. Some of the rates may have resulted from records obtained when a good man was working close to his maximum speed, while others are based on the performance of a medium man at one-third or one-quarter speed From this follows a great inequality and injustice in the reward even of the same man when at work on different jobs." [1]

II. Administratively viewed, the policy is one of "putting it up to" the workman It is, therefore, fundamentally a policy of drift

III. If the splitting of the saved time insures the permanence of the rate, it does so at the cost of depriving the workman of a complete energizer.

By moderating the size of the prize held before the worker the plan, by so much, decreases the incentive and the results achieved. As a consequence production is not greatly increased; and so costs are not greatly reduced.

IV. The fairness of the plan of dividing the profit of saved time between management and men has been called in question.

[1] A Piece-Rate System, F. W Taylor, N Y. Trans. of Am. Society of Mechanical Engineers, 1895, Paper No 647

Mr. Harrington Emerson has said, "If there are no improvements by the employer, there is no reason why the employee should not get in full the increased result due to his greater diligence and skill, but if improvement is due to the employer's better equipment there is no justice in giving the employee any part of it." [1]

V. The workmen can beat the game by spurting on certain jobs to capture a premium, and soldiering on other jobs to rest up, under the protection of the guarantee of day wages.

The Rowan Premium Plan

A somewhat different premium system for sharing saved time has been devised by Mr James Rowan of David Rowan and Sons, Glasgow, Scotland. This system, like that of Halsey, leaves previous conditions of operation and management undisturbed. Standard times are based on experience. Day wages are guaranteed to those who fail to reach the standard. Like the Halsey system also, the chief aim of the Rowan plan is to insure the permanence of the premium rate, by limiting the earnings a workman can make by unusual saving in time.

Briefly stated, the rule of remuneration under this plan is, that the wages of the time taken shall be increased by the same percentage as that by which the time set for the job has been reduced. Under this plan if a workman reduces the time by a certain percentage, he gets an equal percentage of increase in his hourly rate. If the time is cut 25 per cent, the wages are increased 25 per cent. If a workman whose rate is 25 cents per hour finishes an 8-hour job in 6 hours, saving 25 per cent of the time, he receives the hourly rate for 6 hours of $1.50, plus 25 per cent or $0.375, making the job rate $1.875, and the time rate $0.3125 per hour, or $2 50 per day of 8 hours. If the time is cut 50 per cent, the wages are increased 50 per cent, etc. The largest earning it is possible for the employee to make is double the guaranteed wage. And this earning is theoretical, for it is the rate of pay when an infinitesimal of time is taken.

[1] Discussion in Trans of Am Society of Mechanical Engineers, Vol 25, 1903, p. 78.

The fluctuation of the premium may be seen best by putting the wage elements into the form of a proportion:

$$\text{Wages of time set} : \text{Wages of time saved} :: \text{Wages of time used} : \text{Premium}$$

The remuneration is self-limiting for, as the percentage of the standard time saved increases, the base—the wages of used time—to which this percentage is applied, in calculating the premium, decreases. The plan is more liberal than the Halsey system in rewarding improvements up to $\frac{2}{3}$ time economy. From that point on it is less liberal. Inasmuch as the improvement of pace achieved by the unaided efforts of the workmen, under various bonus and premium plans, will seldom exceed $\frac{2}{8}$ or $\frac{3}{8}$, this system is, in practice, more liberal than the Halsey system On the other hand, the self-limiting operation of the premium calculation so reduces the reward for exceptional performance that workmen are not likely to exert themselves greatly Mr. Barth has called attention to this defect as follows "The Rowan plan cannot be very successful in inducing a workman to give away the time in which he can do a piece of work, when the time allowance for this is excessive, for it is then so easy for him to earn a substantial increase over his day wages by only moderate exertions that the slightly higher relative increase that further exertions would net him will not appear to be worth his while."[1] If, as it is claimed, this feature protects the employer from having to pay extraordinary wages, it is hard to see how he gets any advantage from the protection.

An English authority, Sir W. J. Ashley, has said "A moment's reflection will show that the verbal jingle—'the same proportion of the time taken as of the time saved'—contains within it no rational, no logical explanation, of the justice of such an arrangement. The Rowan method, indeed, is now rather declining in popularity among employers."[2]

Since the Rowan plan is so similar to the Halsey system, it

[1] Testimony of Carl G Barth in hearings before the H of R Sp Com on The Taylor and Other Systems of Shop Management, Washington, D C, 1912, III, p 1575

[2] Scientific Management and the Engineering Situation, W J Ashley Oxford Oxford University Press, 1922, p 13

will not be necessary to list separately the advantages and disadvantages of it

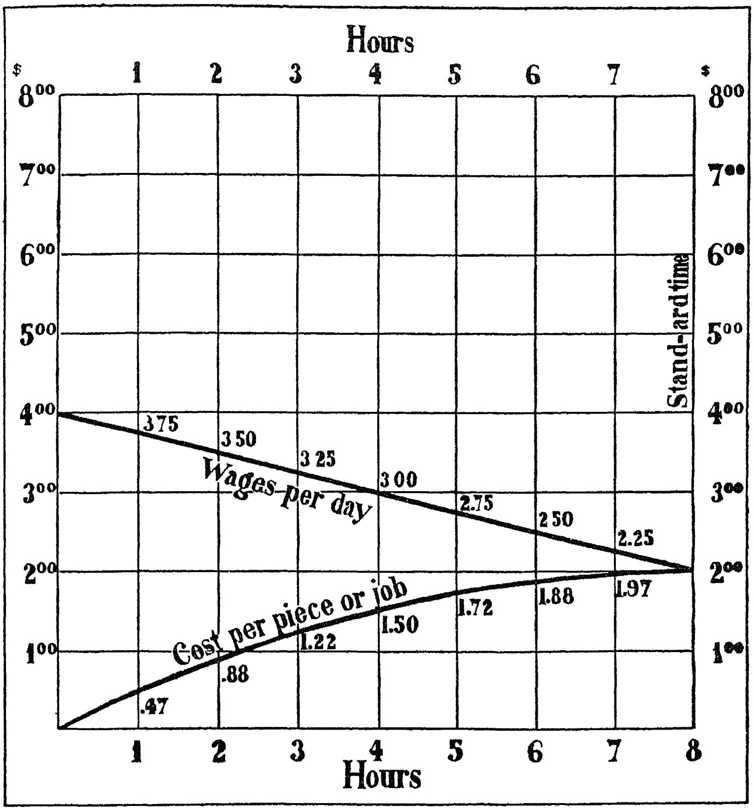

FIG 45 —WAGES AND COSTS UNDER THE ROWAN SYSTEM

Wages per day
Direct-labor costs per piece or job
Standard time 8 hours
Per cent of time saved equals per cent of the bonus

PROBLEMS

Day Rate and Piece Rate.—A workman, who is working an 8-hour day, is offered \$2 00 a piece to turn out certain pieces of work He finds that he can finish a piece in $3\frac{1}{2}$ hours Another employer offers him \$4 00 a day for the same number of hours Which job will give the larger pay?

Labor Cost and Wages.—An employer sets a piece rate at 18 cents, expecting his men to do 21 pieces in 7 hours. He has been paying his men $4 00 a day of 7 hours, and getting 2½ pieces per hour Which plan will give him the lower direct labor cost per piece? Which will enable the men to earn the larger wages per day?

Piece Rates.—A man is offered the choice of two jobs, both on piece rates One job pays $1.50 a piece and a piece takes 2 hours to do The other job requires 7 hours to finish and pays $5 50. Which position will yield the better daily pay?

Profit Sharing and the Origins of Profits.—What is the force of the facts given in the following quotations from Harrington Emerson, with reference to profit-sharing plans for paying labor?

"In building locomotives the costs of direct labor are 15 per cent, the overhead expense 15 per cent, and the material cost 70 per cent. This does not include any general office expenses or selling expense or profit In another plant the raw materials amounted to $32,000,000 a year, the labor costs to $600,000, overhead to $400,000. In this latter case, assuming a manufactured product of 360,000,000 lbs worth $0 10 a lb and a selling cost of $1,000,000, there would be a profit of $2,000,000 or 5 5 per cent—about $0 005 a lb Let prices drop five mills and profits are wiped out, let prices rise five mills and profits are doubled, let an efficient management reduce material wastes 1 per cent and the added profit is $360,000. Let labor deliver twice as much work for the same wages and the gain is only $300,000."

The Basis of Distribution in Profit Sharing.—Mr. Boris Emmet, writing in the Monthly Labor Review of Aug, 1917 (p 48), says "The employer who is the formulator of the profit sharing scheme, usually assumes that his interest in the divisible fund is represented by the amount of his capital, while that of the employees can best be measured by the labor pay roll. Aside from the fact that this assumption is unsound —the earning power of capital rather than its amount being more analogous, if at all comparable, to the labor pay roll—this method of determination of relative interests results in a distribution of the fund in a ratio of at least three to one in favor of capital, for the reason that the annual cost of labor seldom exceeds one-fourth of the amount of capital invested"

Examine the literature of profit sharing, especially "Profit Sharing Its Principles and Practice, Burritt, A. W, and others, N. Y, 1918 Harpers, and report any other basis of distribution found besides that mentioned above

The Halsey Premium.—In a Halsey ½ premium shop, with hourly rates set at 50 cents, a standard time of 5 hours is set for a job. What

would a workman receive for the job if he did it in 6 hours, in 5 hours, and in 4 hours?

Direct Labor Cost under Halsey Premium.—In a Halsey $\frac{1}{3}$ premium shop, with standard time fixed at 20 pieces in 5 hours, and a 50-cent hourly base rate, a man turns out 20 pieces in 4 hours What is the direct-labor cost per piece to the employer?

Day Rate versus Halsey Premium.—Which shop would a workman prefer, a day-rate shop, with an hourly wage of 52 cents, or a Halsey $\frac{1}{3}$ premium shop, in which with 45 cents as the hourly rate, he turns out 4-hour jobs in 3 hours?

Piece Work versus Halsey Premium.—In which shop would a machinist earn more in a day, a straight piece-rate shop, with a job which takes 20 minutes, priced at 20 cents, or a Halsey $\frac{1}{2}$ bonus shop, in which a 30-minute job can be done in 20 minutes, the day rate being 70 cents per hour?

Wages and Labor Costs—Piece Rates and Halsey Premium.—In a piece rate shop, an employer has been getting 8 pieces done for him in 8 hours at a rate of 50 cents per piece With this time and rate as a basis, he changes over to a Halsey $\frac{1}{2}$ premium system, and the output becomes 64 pieces per week. How much increase in weekly wages are the men getting? What has happened to the direct-labor cost per piece in the change?

The Rowan System.—Under the Rowan system with hourly rates at 40 cents, what would a carpenter receive for a 6 hour job done in 5 hours? How much would he receive if he did the job in 2 hours?

The Rowan System (Continued).—Under the Rowan system, with hourly rates at 40 cents, what would a workman receive for an 8-hour day, who performs $2\frac{1}{2}$ jobs of 4 hours standard time each? How much would he get for an extra job if he did $3\frac{1}{2}$ jobs, in place of $2\frac{1}{2}$ jobs per day, and how would this remuneration compare with what he would receive for a job done exactly in standard time?

Halsey and Rowan Plans —What would be the comparative earnings in an 8-hour day, of a machinist, with a 30-minute job finished in 20 minutes, in a Halsey $\frac{1}{2}$ bonus shop, and a Rowan shop? Day wages are 50 cents per hour

Halsey versus Rowan (Continued).—An employer finds that the average past time of a job is 8 hours His day wage basis is 50 cents per hour Which would give him the lower cost per piece, the Halsey $\frac{1}{3}$ system, if the men do the work in 6 hours, or the Rowan system, if the men do the work in the same period?

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CHAPTER XXI

THE NEWER WAGE SYSTEMS

THE TAYLOR DIFFERENTIAL PIECE RATE. THE GANTT BONUS SYSTEM. THE EMERSON EFFICIENCY WAGE

The group of wage systems to be considered in this chapter was designed and put into use as parts of scientific management programs. The early promoters of scientific management found in use various plans of wage payment, such as the daywage, the piece rate, profit sharing, the sliding scale, and cooperation Among these plans, that which most nearly suited their requirements, for a means of paying the individual worker according to his performance, was piece rates. This plan was examined and found to be generally disliked by workmen and opposed by the trade unions The defect of it was found to lie in the fact that rates were set by guess, and later cut when unexpected improvement in production was made, so that the workers retaliated by soldiering, and a futile stalemate of warfare was the result.

To remedy these evils, the leaders planned a series of piece rates of a new type, based upon (*a*) accurate determination of the amount of work held to be proper for a given period of time, (*b*) the guarantee that no rate of pay should be cut nor time of task lowered, except as the conditions of production were so changed as to make the task in reality a new one, (*c*) a rate of remuneration sufficient to secure the good will and active cooperation of the wage earner

It should be observed that the wage plans here considered are simply one agency among many composing the complete structure of scientific management Whereas other systems of wage payment endeavor to find out how much should be done, and secure the performance of it, through the single agency of the incentive offered in the wages; these plans, while not entirely excluding the first aim, depend chiefly upon a very elaborate

process of standardization, a materially reenforced personnel of management, and a refined technique of time and motion study, to make definite the conception of the proper task. To the wage system is left, chiefly, the function of offering an inducement sufficient to secure the cooperation of the wage earner in performing the task set for him.

The Task.—In passing to the consideration of the systems of Taylor, Gantt, and Emerson, it is important to observe that we leave behind those wage plans which are contented with ordinary management, and average employees, and with the attitude of putting the question of improvement of methods up to the workmen. "The great defect common to all the ordinary systems of management," said Taylor, "is that their starting-point, their very foundation, rests upon ignorance and deceit, and that throughout their whole course, in the one element which is most vital, both to employer and workman, namely, the speed at which work is done, they are allowed to drift instead of being intelligently directed and controlled." [1]

The plans here considered aim to control vigorously all conditions, to set the task with scientific accuracy, to make the task difficult enough to be worthy of a first-class man, and to offer a generous reward for successful performance, withholding from the laborer no portion of the advantage he earns by doing better or more rapid work.

The novelty of the conditions which a scientifically managed shop at first presented was such that previous records of performance, and the customary accomplishments of ordinary shops, had no application; there existed, therefore, no precedents from which to judge how long it should take to do work. This problem was gone into with the same thoroughness displayed in perfecting the other agencies of the system.

The standard of labor measurement chosen has often been referred to as the "first-class man standard." The standards of scientific management are high. Those who install an excellent shop equipment and provide excellent management and shop services cannot logically set any other than excellent tasks and invite excellent wage earners to join them, if they are to conform to the fundamental rule of administration—discussed in Chapter

[1] Shop Management, F. W. Taylor, N. Y Harpers, 1911, p. 45.

VII—that only analogous qualities of the factors of production should be united.

There was, however, another object in setting the standards high, and that was to avoid the great increase in output above what was expected, and so the unexpectedly high rates of wages which had occasionally characterized the ordinary piece-rate system; and which became the bone of contention between management and labor. Instead of setting a rate by guess, and later revising it in the light of the revelations made by wage earners, scientific management aims to make all the improvements first, and then set a rate of production that the workman can never so greatly excel as to make it necessary to change the rate.

The stiffness of the tasks recommended in connection with the wage systems of this chapter is not the same. The Taylor system, as used for a time at the Midvale Steel Company plant, has the highest standards. The Emerson standards are more moderate. It has been stated that, under typical Taylor and Gantt installations, a performance of 110 per cent is rare, while the ordinary worker can make only 100 per cent with exceptional training and experience. At the Bethlehem Steel plant, Taylor set standards so high that barely one man out of five, of an average assortment, was able regularly to conform to them. Other experts set standards with which well-trained men can make records of 100 to 125 per cent. The Emerson standards, which are not so much conceived of as ultimate goals as important initial tests of competency, to be passed as full efficiency is approached, may be surpassed by first-class workers with records of 125 to 150 per cent.

As to the permanency of the task standard, it is a cardinal point of scientific management that a rate once set should not be cut unless the methods of working, or the equipment, or some other essential factor of production, independent of the control of the worker, requires change, so that what is virtually a new task has to be set. Such a revision—presuming on a consistent and intelligent management—should work no hardship upon the worker, as the new task will be set in conformity with the same standards of task severity as the old. That this provision for task revision opens the way for unfair rate cutting may be admitted, but there is no alternative to this policy of revising tasks from time to time, because no management can agree to deed away to their

employees all the advantages which may accrue in the future from the evolution of the arts of production.

The Incentive.—The first problem with reference to wage incentive is as to the amount which should be offered to induce men to surpass average or ordinary standards of performance, and regularly achieve a higher standard set by tasks. "The exact percentage," said Taylor, "beyond the usual standard which must be paid to induce men to work to their maximum varies with different trades and with different sections of the country."[1] As a result of experimentation he found himself between two difficulties On the one side was the difficulty of not offering enough to secure the talent and the energy required. On the other was the danger of offering so much that workmen were either led into dissipation which destroyed their ability, or they became irregular in attendance, earning enough during a part of the week to purchase leisure for the remainder of it. That these latter difficulties are very real ones was amply proved by the effects of war wages in the United States.

Mr. Taylor further says "The writer has found, after making many mistakes above and below the proper mark, that to get the maximum output for ordinary shop work requiring neither special brains, very close application, skill, nor extra hard work, such, for instance, as the more ordinary kinds of routine machine shop work, it is necessary to pay about 30 per cent more than the average. For ordinary day labor requiring little brains or special skill, but calling for strength, severe bodily exertion, and fatigue, it is necessary to pay from 50 per cent to 60 per cent above the average. For work requiring special skill or brains, coupled with close application, but without severe bodily exertion, such as the more difficult and delicate machinist's work, from 70 per cent to 80 per cent beyond the average And for work requiring skill, brains, close application, strength, and severe bodily exertion, such, for instance, as that involved in operating a well-run steam hammer doing miscellaneous work, from 80 per cent to 100 per cent beyond the average"[2]

A second problem with reference to incentive is how to dis-

[1] A Piece-Rate System, F W Taylor, N Y Trans of Am Society of Mechanical Engineers, 1895, Paper No 647

[2] Shop Management, F W. Taylor, N Y Harpers, 1911, p 26

tribute it with reference to performances at different rates of speed or with different qualities of workmanship. Shall the reward be spread along from some moderate point of efficiency which is certainly within the reach of a well-chosen man, and in such a manner as to tempt him to exert himself, and to offer him an attractive scale of rewards for an ascending scale of steps toward efficiency? Such appears to be the method of the Emerson system. Or, shall it be piled up sharply at the point where a difficult task is accomplished, so as to discourage all who cannot "make the grade," and offer a prize sufficient to attract exceptional men from all sides? This seems to be the object of the Taylor plan.

The Taylor Differential Piece Rate

The author of this system was Frederick W. Taylor, the principal originator and the leading exponent of scientific management. The plan was first applied practically in the works of the Midvale Steel Company at Philadelphia in 1884, but it was never used elsewhere by Mr. Taylor.

The basic principles of the system are thus set forth by their author:

(*a*) A large and clearly defined daily task for each man
(*b*) Standardized conditions and appliances to make performance, in the time allotted, regularly possible for a first-class man.
(*c*) High pay for success
(*d*) A low rate, barely equal to day wages, and eventual discharge, for failure

The preliminary requirements for the successful introduction of the differential piece rate are strictly standardized shop conditions, and a reenforced shop administration able to give the workmen personal explanations and demonstrations, complete written instructions, and unusually perfect service aids of all sorts.

The standard time of each job is set with great care, on the basis of motion and time studies. The time allowance is adjusted to make the task a difficult one, expressing about all that a first-class man, who is well instructed in his work, should be asked to do regularly. The exact task standard will depend upon the state of the labor market and the possibility of securing the quality of

men desired The aim is to be liberal with the premium rather than with the time base. Taylor sets out to pay exceptional men roundly for exceptional work; whereas Halsey and Rowan aim to coax ordinary men along a moderate course of improvement.

Since so much care is used in setting the time base, and so much administration effort is devoted to keeping all the conditions such that there will be no cause outside of the workman's own volition why he should not accomplish his task, it is logical that the rate of pay should be so adjusted as strongly to stimulate the workman to do his part. This stimulus is produced by using two piece rates. For those who fall below the standard in quantity or quality of work, a piece rate is fixed which is so low that the workman will earn less than day wages and so, after attempting to reach the standard but failing, will quit and go elsewhere. This low rate of pay was intended not as remuneration for the work done, but as a mere retainer wage to cover the employee's cost of living while he was learning, and trying to "qualify for the team."

For those who succeed, a very high rate of pay—from 30 to 100 per cent higher than the average of the trade—is fixed. This attracts the superior men, stimulates them to do their best, and pays them more than they can earn elsewhere.

The plan differs from straight piece work by using two rates, a lower one for unsatisfactory work, a higher one for satisfactory work. Like piece work, however, it gives the workman all the wages of the time he is able to save. Mr. Taylor scorned the idea of taking from the worker any part of his wages of saved time. The employer should be content with the low overhead charge of the fast pace.

The rate having once been set should never be cut. The time base is to be revised whenever the conditions of production furnished by the management are altered in such a way that the task set is virtually a different one. It will be observed from the chart that the workman who just fails to reach the standard receives $1.60 per day, while the pay for attaining the standard is $2.40 At the division line between satisfactory and unsatisfactory performance the contrast in remuneration is marked There is thus set up a vigorous culling action, which attracts the attention of the management strongly to those employees who are

not earning the bonus Of this feature Mr. Taylor said, "It automatically selects and attracts the best men for each class of work, and it develops many first-class men who would otherwise

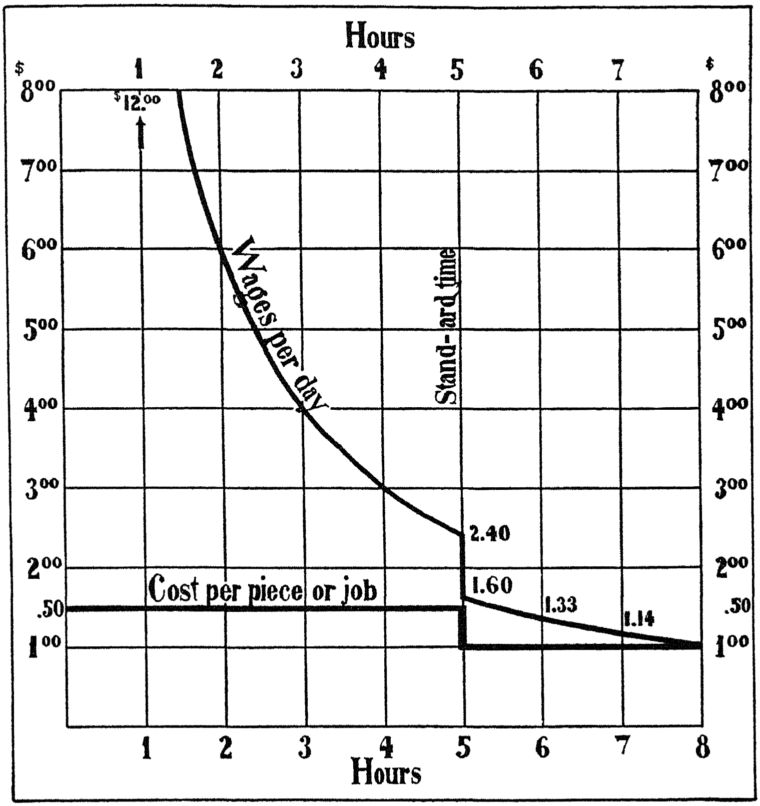

FIG. 46 —TAYLOR DIFFERENTIAL PIECE-RATE SYSTEM

Wages per day.
Direct-labor cost per piece or job
Standard time 5 hours
Piece rates $1 00 and $1.50.

remain slow and inaccurate, while at the same time it discourages and sifts out men who are incurably lazy or inferior." [1] And elsewhere he said that it "not only pulls the man up from the top

[1] A Piece-Rate System, F. W Taylor, N. Y Trans Am. Society of Mechanical Engineers, 1895, Vol 16, p 858.

but pushes him equally hard from the bottom." The system is, therefore, two things in one. a test or examination for competency, and a plan of remuneration which is more generous than any other for the successful worker.

Rewards are to be calculated on the basis of a period of time, say a day or a week, so that sustained performance is required. Failure on one job will offset success attained on another.

Although the system is cast in the form of two piece rates joined together at the task point, it is in reality more of a task system with a high and low time-rate. This idea, indeed, Mr. Taylor expresssed in his testimony in 1910, before the Special Committee of the House of Representatives, in which he said: "I want to make the fact perfectly clear that there is no implied bargain under scientific management that the pay of the man shall be proportional to the number of pieces turned out. There is no bargain of that sort. There is a new type of bargain, however, and that is this· Under scientific management we propose at all times to give the workman a perfectly fair and just task, a task which we would not on our side hesitate to do ourselves, one which will never overwork a competent man." [1]

This plan of wage payment should not be given too much importance as a part of Mr. Taylor's system, as its author did most of his work under other systems He was chiefly interested in setting a definite task which called for high efficiency, and in paying generously to have it done. The exact technique of payment was a secondary matter. Nevertheless, the differential piece-rate system is characteristic of Mr. Taylor. He was strenuous in his activity, demanding much of others, and least of all sparing himself. He delighted in the highest standards of thoroughness and efficiency; and had the strongest repugnance to soldiering in all its forms. He aimed at low-unit costs by large production; and hoped by this means eventually to bring price reductions, by which the public should receive its share of the benefits of progress.

Advantages.—I. There is in this system the stimulus of high standards. Of the management there is demanded complete mastery of conditions, and the ability to set a definite task; of

[1] Frederick W. Taylor, Frank B. Copley, N. Y Harpers, 1923, Vol II, pp. 126–127.

the workman there is required a performance which demonstrates him to be a first-class man of his trade.

II. The functions of management and of performance are clearly distinguished. The management sets the conditions, and in that setting determines its profits; the men put forth their efforts as operatives, receiving all the wages of gained time.

III Under this system, more than any other, the wage earners hold the management to strict account to provide the conditions for efficient production, without breakdowns or delays.

Disadvantages.—I. The culling action at the point of achieving the task is so severe that the definition and measurement of the task, and the control of each of the conditions set for the workman, must be attended to with great care to avoid complaint and a sense of injustice. This point Mr. Taylor recognized, for he said, "When the work is of such variety that each day presents an entirely new task, the pressure of the differential rate is sometimes too severe. The chances of failing to quite reach the task are greater in this class of work than in routine work; and in many such cases it is better, owing to the increased difficulties, that the workman should feel sure at least of his regular day's rate which is secured him by Mr. Gantt's system in case he falls short of the full task." [1]

II. Because of its exacting nature the system has a limited range of applicability in industry. It can succeed only where first-class operatives work under conditions controlled by scientific management.

The Gantt Bonus System

The system sometimes described as "task work with a bonus" was devised by Mr. H. L. Gantt, while associated with Mr. F. W. Taylor at the works of the Bethlehem Steel Company. It is based on the Taylor differential piece-rate system and is, as Mr. Gantt says, "As far as possible removed from the old-fashioned method of fixing piece rates from records of the total time it has taken to do a job."[2] It is the most widely used of the scientific management wage payment plans.

[1] Shop Management, F W Taylor, N Y Harpers, 1911, pp 78–79.

[2] A Bonus System for Rewarding Labor, H L. Gantt, N Y Trans of Am. Society of Mechanical Engineers, 1902, Papers No 928

Upon the basis of strictly standardized shop conditions Mr Gantt sets a definite daily task which represents a first-class performance "If a man follows his instructions, and accomplishes all the work laid out for him, as constituting his proper task for the day, he is paid a definite bonus in addition to the day rate which he always gets. If, however, at the end of the day he has failed to accomplish all of the work laid out, he does not get his bonus, but simply his day rate."[1] The pay of those who attain or excel the standard consists, then, of the day rate for the time allowed as standard for the task accomplished, plus an agreed percentage—anywhere from 20 to 50 per cent—of that time calculated at the day rate, added as a bonus. Let us assume a case where the day rate is 25 cents per hour, and the bonus is 20 per cent of the standard time If a workman completed a 5-hour job in 6 hours, he would receive the day rate for 6 hours, or $1 50 for the job, which is at the rate of $2 00 per day. If he did the work in 5 hours he would receive the day rate for 5 hours, plus 20 per cent of 5 hours, or a total wage of 6 hours, or $1 50 for the job, which is at the rate of $2.40 for the day. If he did the work in 4 hours he would still receive the day rate for 5 hours, plus 20 per cent of 5 hours, or the hourly rate for 6 hours, making $1 50 for the job, or at the rate of $3 00 per day.

The system is obviously a day wage for sub-standard workers, and a piece rate for men who are standard or better. The difference between the Taylor and Gantt systems is that for sub-standard workers the Gantt system guarantees day wages, while the Taylor system does not; and that for workers who are standard or better the Taylor system pays by the piece, while the Gantt system pays in terms of time calculated at day-wage rates

By standardizing production definitely at the rate set by the task times, costs are made predictable as in the Taylor system.

Mr Gantt considers the guarantee of the day wage essential, because it reassures a labor force and facilitates the transfer of a shop onto scientifically set piece rates.

As Mr. Gantt pays a liberal bonus for satisfactory performance, there is a culling action just at the point of attaining the standard, though it is not as severe as under the Taylor system

[1] A Bonus System for Rewarding Labor, H L Gantt, N Y Trans of Am Society of Mechanical Engineers, 1902, Papers No 928

To prevent hardship, however, Mr. Gantt provides that only those who are properly instructed, and likely to succeed, shall be allowed to try for the bonus. The workmen who remain on day wages are looked upon as overpaid during a temporary apprenticeship, pend-

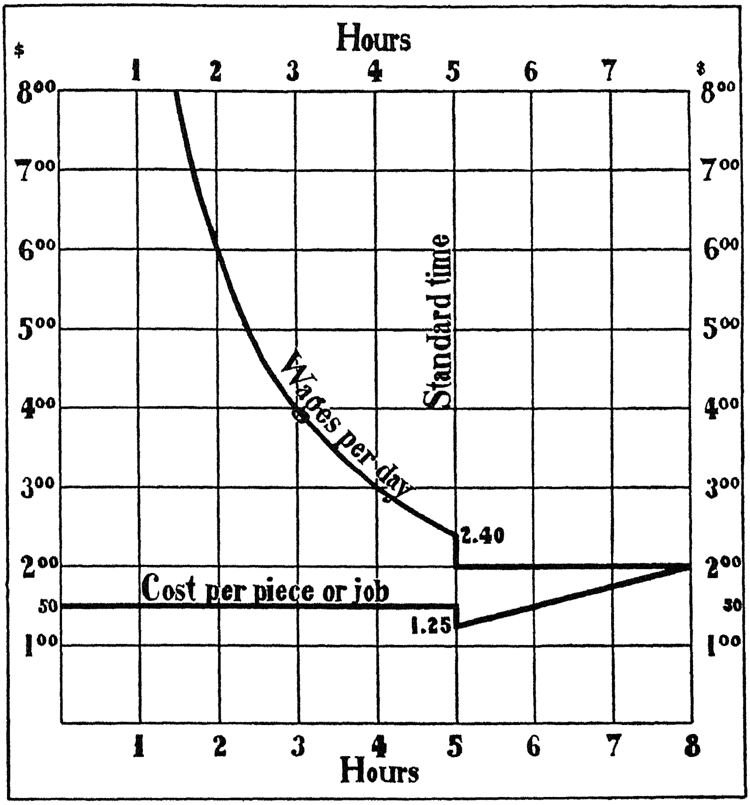

FIG. 47.—WAGES AND COSTS UNDER THE GANTT BONUS PLAN

Wages per day
Direct-labor costs per piece or job.
Standard time 5 hours
Day rate 25 cents per hour
Bonus 20 per cent of standard time.

ing their attainment of the standard. As the guarantee of day wages weakens the culling action and reduces the strength of the motive for attaining the standard, Mr. Gantt employs various

agencies to bring a shop up to the standard. To arouse the foremen to assist heartily, a bonus is paid them proportional to the number of their men who attain standard; and there is besides an extra remuneration when a shop is composed entirely of bonus workmen. It is to be noticed that this bonus is upon the proportion of the men who succeed in attaining standard, and not upon the earnings of the men. The foremen are encouraged to aid the men to get into the bonus class, but not to drive them beyond what the management has set as a fair day's work.

The Emerson Efficiency Wage

The system devised by Mr Harrington Emerson is like the Taylor and Gantt systems in that shop conditions are thoroughly standardized, that the tasks are carefully set by time studies, and that these tasks constitute, when performed in standard time, about all that a first-class man should do It further resembles them in that the worker is paid for all the time he saves above the standard, and that the assistance of counselors and production experts is provided for the workers. It agrees with the Gantt system in guaranteeing day wages as long as a man is retained, regardless of performance The hourly rate, or day-wage rate, corresponds with the current rates of the locality.

The distinctive feature of the plan is the gradual nature of the transition effected from the day rate to the piece rate as performance improves.

Remuneration is on the basis of efficiency A workman's efficiency is the ratio between the time set and the time he has taken, that is to say, between the standard hours of his finished jobs and the clock hours he has consumed. If in a month a man finishes jobs having a total standard time of 180 hours, and has worked 240 hours, his efficiency is $\frac{180}{240}$, or $\frac{3}{4}$, or 75 per cent. If he has in 240 hours finished jobs the standard times of which total 300 hours, his efficiency is $\frac{300}{240}$, or $\frac{5}{4}$, or 125 per cent.

The accomplishment of the task in standard time is 100 per cent efficiency For men who are 100 per cent efficient, the wage is the rate for the allowed time (which in this case is the same as the time used) plus 20 per cent of the time used. The bonus begins at 66 7 per cent efficiency For slower performance than this day wages only are paid A man who cannot attain 80 per

cent efficiency is deemed to be engaged on the wrong kind of work, and is changed as soon as opportunity permits. Between 66.7 per cent and 100 per cent efficiency the worker receives, in addition to his day wages, a percentage bonus calculated on the wages of the time used, which increases gradually to 20 per cent as an efficiency of 100 per cent is approached. These bonuses of the approach to the standard are calculated from the positions of a certain parabolic curve connecting the day-wage line at 66.7 per

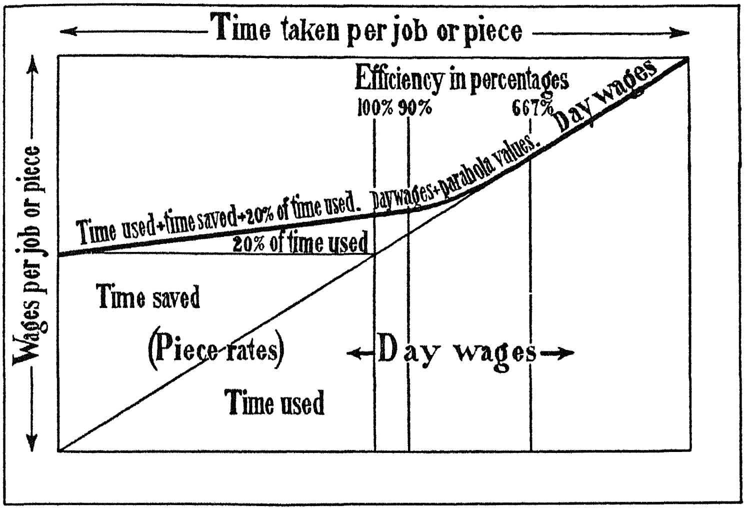

FIG 48.—COMPOSITION OF THE EMERSON EFFICIENCY WAGE

cent efficiency with the point of 120 per cent of day wages which is the remuneration for 100 per cent efficiency

The better to reveal the construction of the Emerson wage, we insert a special chart showing the change which takes place in remuneration as a given job is done in different times. (Fig. 48)

The simplified bonus table which is used in practice, for calculating the parabola values, groups the efficiency percentages upon whole numbers of bonus percentage.

It will be noticed that above 90 per cent efficiency the bonus increases 1 per cent for each increase of 1 per cent in efficiency, until 100 per cent is reached. For all efficiencies above 100 per cent the workman receives the wages of the time used and of the

SIMPLIFIED BONUS TABLE

PERCENTAGE OF EFFICIENCY	PERCENTAGE OF BONUS	PERCENTAGE OF EFFICIENCY	PERCENTAGE OF BONUS
67 00 to 71 09	0 25	89 40 to 90 49	10
71.10 " 73 09	0 5	90 50 " 91 49	11
73 10 " 75 69	1	91 50 " 92 49	12
75 70 " 78 29	2	92 50 " 93 49	13
78 30 " 80 39	3	93 50 " 94 49	14
80 40 " 82 29	4	94 50 " 95 49	15
82 30 " 83 89	5	95 50 " 96 49	16
83 90 " 85 39	6	96 50 " 97 49	17
85 40 " 86 79	7	97 50 " 98 49	18
86 80 " 88 09	8	98 50 " 99 49	19
88 10 " 89 39	9	99 50 and over	20

time saved—that is to say piece rates—plus 20 per cent of the wages of the time used.

To summarize:

Efficiencies 66.7 per cent and less receive time used.
Efficiencies 67 per cent to 100 per cent receive the time used plus parabola bonuses.
Efficiencies 100 per cent and over receive time used plus time saved plus 20 per cent of time used.

Advantages.—I. The gradual increase of the bonus above day wages from 66.7 per cent to 100 per cent efficiency, and the gradual decrease of the bonus beyond 100 per cent down to piece rates, makes an easy transition from the day rate to the piece rate. The learner is encouraged to strive and to learn by gradually increasing rates of remuneration. In comparison with the Taylor and Gantt systems, the philosophy of this system is less that of culling for native capacity, and more that of bringing men up to the standard by persistent effort, patient instruction, and growing reward. Those who fail to reach the standard are not discouraged by being thrown back upon the flat day rate.

II. Since there is not at any point a great drop in remunera-

tion, by reason of barely failing to attain some specific standard of performance, the question of the exact degree of liberality employed in setting the time base, and the matter of the accuracy used in

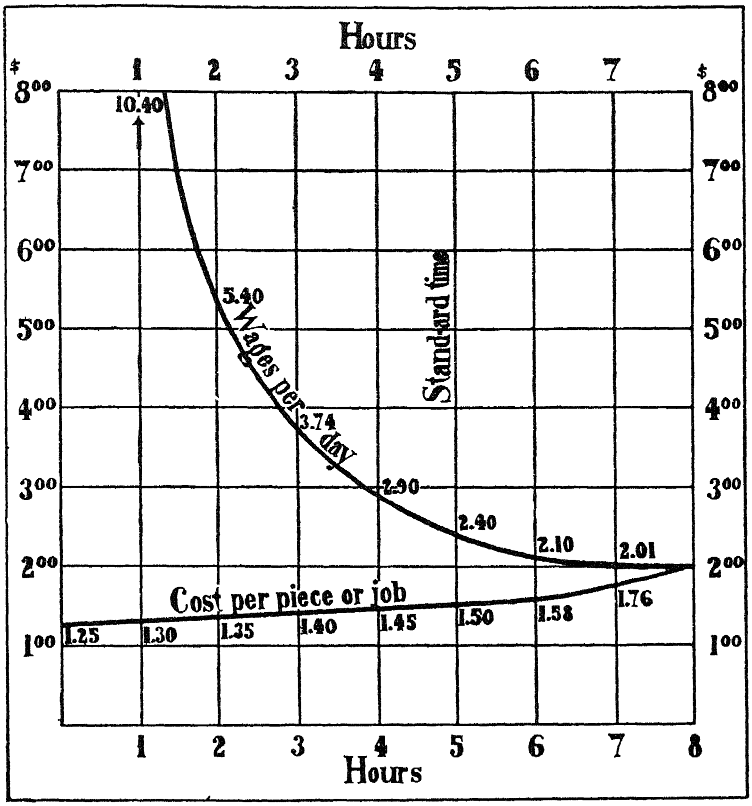

FIG 49 —WAGES AND COSTS UNDER THE EMERSON EFFICIENCY PLAN

Wages per day.
Direct-labor cost per day or job
Standard time 5 hours
Day rate 25 cents per hour

measuring those jobs which are on the edge of the standard, is not of so great importance as in shops with the Taylor or Gantt systems.

III. The worker has freedom to adopt a natural or comfortable pace of working. As Mr. Emerson says: " The worker must have

the personal option of working not to a standard time, but between limits on each side of standard time." [1]

IV. The percentage of efficiency is not calculated in practice for each job, but for a period of from two weeks to a month. The employee can thus make up on some jobs for a failure on others, so as to avoid the loss of his bonus. While day wages are paid weekly, the bonus may be calculated and distributed every other week or every month. This saves pay roll expense. It also prevents the workman from beating the system by resting upon day wages after a raid on the premium. It causes a shop to be somewhat less on edge with reference to the attainment of the exact standard on each job.

V. Accurate labor costs are, of course, distributed to each job by the cost keepers But, since the rate of production is not strictly standardized upon a task rate, the element of overhead costs per job is variable, and costs are not so exactly predictable as under the Taylor and Gantt systems

Conclusion on the Newer Systems of Wage Payment

Not a Distribution of Profits.—The various wage systems which have been reviewed reveal two chief purposes: (*a*) to offer an increase of wages to the employee in exchange for a better performance and (*b*) to reduce costs to the employer as the reward for better management. Since an increase in efficiency produces an extra sum of profit, it is easy to get the idea that the problem of devising a satisfactory wage plan is the problem of making some equitable division of this profit.

It should be understood that the bonus and premium and differential piece-rate plans of paying wages are not attempts to put upon the worker any portion of the hazard of the uncertain relation between costs and prices, and so inaugurate a new form of profit sharing. They are simply efforts to find a workable relation between the current wages which pay for ordinary efforts, and the extra remuneration which will adequately pay for extra labor service.

Distributive Justice.—Professor Robert F. Hoxie criticized scientific management for not having worked out a more just for-

[1] Twelve Principles of Efficiency, Harrington Emerson, N Y. Engineering Mag Co, 1912, pp. 360–361

mula for the distribution of income as between capital and labor. The formula used by scientific management is the same as that used by the economists, namely, supply and demand. Professor T. N Carver has said: "I know of only one approximately satisfactory price for any commodity and that is a price which will tempt producers to produce as large a product as buyers are willing to buy at the price, or which will tempt buyers to buy as much as producers are willing to produce at the price. If the price is sufficient to call forth an adequate product, producers must find it relatively satisfactory. If buyers are willing to buy the whole product, they must find the price relatively satisfactory. . . . It is not necessary to go very far into the question as to what determines the equilibrium wage in any occupation. It is rather obvious that the demand for labor in any productive occupation in some way depends upon the productivity of labor. . . . No wage board, however, would need to waste any time trying to figure out the marginal productivity of labor. The equilibrium of demand and supply would be a better indication than any figures that any body of experts would be likely to find. All they would need to do would be to see whether the wages were sufficient to attract into the occupation as many workers as employers were willing to employ." [1]

The economists ask, chiefly, that supply and demand be free and intelligent. Scientific management has made the greatest contribution of any recent economic movement toward freedom and intelligence in the operation of the competing forces which fix wages. This it has done by its superior method of standardizing the majority of the elements involved in a contract to perform labor, and by its superior process of measuring and recording others, and of making public exact information with reference to them.

The true problem of wages under scientific management, or under any other type of management, is not to divide a profit, but to find the levels of remuneration which will insure the necessary cooperation of operatives and staff workers, while yet offering to capital sufficient interest and profits to insure its cooperation. If there is any surplus beyond these requirements it will be left with the entrepreneur or final risk-taker, pending such an

[1] The Equilibrium Wage, T N. Carver Annals of Am Academy of Pol. and Social Science, March, 1922, Vol 100, pp 77–79.

increase of competition between entrepreneurs as will hand it over to the public in the form of lower prices

There is no logical process, nor abstract principle, nor fixed relation of wages to profits, available for determining what fair wages or workable wage levels are Experiment with supply and demand is the sole original source of information in an industrial society organized under the system of free competition Enough must be paid the laborers to insure the necessary response in numbers, in native talent, in energy, and in hearty cooperation All that administrative effort can do is to make more definite the terms of the wage problem by dispensing with all ambiguities as to the conditions, as to the talent required, and as to the nature of the task, and thus by disposing of all collateral issues, facilitate the focusing of supply and demand upon the crux of the question, namely, the relative value of a unit of muscular and nervous energy expended in labor, in comparison with a unit of managerial brain power, and a unit of self-denial and nervous tension involved in saving and risking capital

Problems

Taylor Differential Piece Rate.—Under the Taylor differential piece-rate system, with rates set at 25 cents and 20 cents, and standard time set for a job at ½ hour, one man takes on the average 35 minutes for the job, while another takes 25 minutes What are these men earning per day of 8 hours?

Taylor versus Halsey.—With an hourly rate of 50 cents and a Halsey bonus of ½, a man does 8-hour jobs in 5 hours He is offered a position in a Taylor shop on a job with standard time set at 5 hours and piece rates of $3 50 and $2 50 in force Assuming that he can do the job in the Taylor shop just within the time set, which shop would permit him to make the larger daily earnings?

Straight Piece Work versus Taylor Rates.—Which system would a workman prefer, on the ground of earnings possible per day, a shop with straight piece work, where he would be given a job priced at $4 00, standard time 8 hours, on which he could cut the time 25 per cent, or a Taylor piece-rate shop with a standard time of 5 hours and price rates at $3 00 and $2 00, on which he could cut the time but 10 per cent?

The Gantt Bonus System—Under the Gantt system, with a 6-hour job, and a 25 per cent time bonus, what would a 60 cent per hour man draw who did the work in 5 hours and 40 minutes?

Different Gantt Percentages.—Would a workman, such as is referred to above, prefer a Gantt shop with a time base of 6 hours for a job and a 25 per cent bonus, or a second Gantt shop with 5 hours as the time base, and a 30 per cent bonus, assuming that the hourly rate was the same in each case, that the workman just made the standard in each case, and that the preference was based on comparative hourly earnings regardless of effort required?

The Emerson Way.—In a shop with the Emerson efficiency wage, and an hourly rate of 50 cents, a workman in 6 days of 8 hours each did 42 jobs of a standard time of 1 hour each. What wages would he receive? What wages would he receive if he finished 48 such jobs in a week? What, if he finished 60 jobs in a week?

The Emerson Wage Continued.—If day wages are 60 cents per hour, and standard time for a certain job is 5 hours, what will a man receive for a 48-hour week, who turns out 10 pieces? What would he receive if he turned out 8 pieces?

Emerson Wage and Different Rates of Working.—Under the Emerson efficiency wage, with an 8-hour day, and 60 cents as the hourly rate, a man takes 3 days to finish 7 jobs of a standard time of 4 hours each. What is the job cost and the day wage under these conditions? If this workman slowed down to 5 jobs completed in 3 days, what would be the job labor cost and the day wages?

Emerson versus Gantt Wages.—A workman in a shop using the Emerson efficiency wage, with an 8-hour day, finished $5\frac{1}{3}$ jobs of 10 hours standard time each in a 6-day week. If the day wage were 50 cents per hour what would be his total wages? For the same work what would the man have earned if his shop had been using the Gantt task system with a 30 per cent bonus?

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CHAPTER XXII

WELFARE ACTIVITIES

Welfare work, or betterment work, or personnel service work in industry, are various titles which may be used to designate the voluntary efforts of employers to improve the condition of their employees. These efforts aim to procure benefits which are beyond what the law requires or the necessities of competition exact. Among the activities which may be included under this head are those which have to do with hygiene and sanitation, medical aid, accident prevention, group insurance, educational opportunity, thrift promotion, wholesome food for the midday meal, social advantages obtained through employee organizations, housing, and community betterment.

The welfare movement is one which owes its origin to the initiative of employers who have pioneered in the face of the opposition of labor organizations, and who have borne the epithet "paternalism" from those who think that business must normally be the pursuit of profit regardless of society's needs. It marks the revolt of men of good education and modern ideas against the narrow utilitarianism which characterized the earlier history of the factory system; and against the influence which big business has exerted in recent decades, in the direction of separating men from each other in work and rank and interests and standards of life.

The movement is an entirely practical one,—a business man's affair—owing little to professional reformers, having nothing to do with charity, and allowing small influence to comprehensive theories of social reform. The instinct behind the movement is the natural desire of those who labor together to deal humanly with each other, and to assist each other to attain good health and efficiency, to enjoy the basic comforts of life, and to sustain normal human fellowships.

As the per capita production of wealth of the country increases, the conditions of life of the people can be improved. We can enjoy better homes and schools, better food and clothing, better reading and recreation, because there are more of the good things of life available. It is reasonable that, as other classes elaborate the arts of living, the working classes should rise in the scale of comfort as well. And since these classes spend so large a part of their waking hours in work places, it is natural that this advancement should show not only in the family life, but in a progressive improvement of the conditions of the working day.

Extent of Welfare Work.—The personnel service or welfare movement is no longer an experiment, although its methods are experimental and flexible. It now comprises manifold activities regularly carried on by the leading manufacturers and merchants of the country. In 1917 the United States Government published a list of some 1400 firms prominent in welfare work The list can almost be called the aristocracy of American business

Functions.—Some of the misfortunes and disasters to which the wage earner's life, and that of his family, are subject are (1) lack of training, (2) unemployment, (3) accident, (4) sickness, (5) inadequate housing, (6) lack of social and recreative opportunities, (7) premature death, (8) old age without adequate financial provision.

How shall the advance of economic society deal with these great ills? Individual initiative is now the chief reliance But when this fails, the victim is thrown upon charity, which is late in arriving, is superficial, insufficient, and temporary, is ill organized, and is destructive of independence, and subversive of the normal value sense. Cannot these economic goods which the wage earner so greatly needs be produced by the normal capitalistic process? If the modern corporation, with its great material resources, and its array of talent in staff and ranks, is so successful in producing goods and services for the general market, why should it not be efficient in producing service—protection against the major misfortunes and disasters of life—for its own members? The beginning of efforts to make the corporation do this new kind of work constitutes the welfare movement.

Accidents and the Safety First Movement

"It has been estimated that among the 40,000,000 industrial workers in the United States there are 2,000,000 lost-time accidents yearly, entailing a loss of time of more than one day each. Of this number there are 750,000 workers who sustain a disability of more than four weeks' duration. About 22,500 are killed, and from 15,000 to 18,000 more suffer permanent disability. This loss is estimated to be more than 18,000,000 man-days per year, or the working time of over 60,000 persons." [1] American industry has the unenviable reputation of being the most reckless in the world.

Workmen's Compensation Laws.—In 1908 the United States Government passed the first workmen's compensation law, granting compensation for accidents to certain classes of Federal employees. In New York State, in 1910, a compensation law was passed which covered a limited number of hazardous occupations. In 1914 New York enacted a general compensation law. During the five years 1911–1915, inclusive, compensation laws were passed in thirty-one states and two territories. These laws not only assessed heavy and certain damages upon employers in case of disability of employees by reason of accident, but they put into operation a system of record keeping and reporting from which employers soon learned the significance of the accident situation. The result was the immediate starting of the movement to banish accidents.

The safety-first campaign has been continued and expanded until it is now the most widely accepted of all forms of welfare work. It is primarily responsible for the introduction of the surgeon, the nurse, the first-aid room, and the hospital, into industry.

Accident Statistics.—The basic statistics used in reporting and comparing accident records are accident frequency rates and accident severity rates. Accident frequency is the number of lost-time accidents per 1000 full-time workers (total time worked being reduced to terms of workers employed 300 days per annum

[1] Human Engineering—A New Medical Specialty, Frank L Rector. United States Public Health Report, January 9, 1920, Vol 35, pp 61–62.

of 10 hours each) Accident severity is the number of days lost annually per full-time worker.

A good accident record is now considered to be one which shows a loss of $\frac{1}{2}$ of 1 per cent, or $\frac{1}{4}$ of 1 per cent, or less, of the time of a full-time worker.

Causes.—As a result of the study of accident statistics, it has come to be generally agreed that, with good modern practice, the state of the equipment, and unavoidable circumstances, will account for from 10 to 25 per cent of the accidents, and the human factor—carelessness, ignorance, inexperience, lack of supervision, etc.—is responsible for the remaining 75 to 90 per cent

Accidents and Mechanism.—Taking up first the mechanism, it is instructive to review the danger points as they have been listed by Mr. John Calder. "The elements common to all 'dangerous machinery,' and which, if unguarded or of unsafe form are found to inflict injuries when within the reach of any worker, will be found to be chiefly as follows:

> (*a*) The intake sides of all engaging toothed or other gears, rolls, drums and slides of every description on any machine
>
> (*b*) The space between fixed and moving parts of any machine, or between the latter and structures near it, leaving insufficient working clearance for any person employed thereon, or near it
>
> (*c*) Pulleys and clutches
>
> (*d*) Belts, bands, and driving chains
>
> (*e*) Flywheels
>
> (*f*) Shafts and spindles and projections thereon or upon reciprocating parts
>
> (*g*) Counterweights and balance weights
>
> (*h*) The actual operating element on a machine, such as circular saws, the punch and die in the press, the revolving cutter in the milling machine, etc
>
> Of these elements (*h*) is by far the most dangerous and the most difficult to safeguard "[1]

An infinite variety of safety appliances has been designed by the engineers. A few of them are. housing for emery wheels and

[1] Scientific Accident Prevention John Calder. American Labor Legislation Review, Dec, 1911, Vol I, No 4, pp 17–18 At the time this was written Mr Calder was the General Manager of the Remington Typewriter Works

plate-glass eye protectors, safety nets in connection with builder's and decorators' scaffolds, self-locking doors for openings into elevator shafts, electric push buttons for starting and stopping machines, guards which release machines for starting only when in place, starting devices which require both hands to operate, magazine feeding devices, rotary tables for carrying work into and out of machines, the use of compressed air to expel finished work from the machine, a guard that pushes aside the hand as the ram of a press descends, and jigs to hold work in tapping machines. One of the principles of safety engineering is that the work must be brought to the tool, and not the tool to the work, so that the tool may always operate in a safe setting.

Three general rules of the United States Steel Corporation, pertaining to safety in equipment, are as follows:

"In the construction of buildings and designing and placing of machinery the safety of the workman is equally as important as the production of the machine and economy of its operation Leave ample clearance and provide passageways for traffic and escape.

"All requisitions on the purchasing department for machinery should specify 'Standard safety requirements have been considered, and those not to be furnished by the maker will be installed at the plant.'

"All drawings or blue prints should be checked for safety before leaving the drafting room, and so noted by initials of persons checking in space provided in title of drawing."

The Human Factor.—Turning now to the consideration of the human factor in accident causation, the records of accident distribution show that the dangerous ages are from 16 to 20, and over 50. Negroes are more subject to accidents than whites. Where men and women do the same work, men have higher rates than women. Single men are more often injured than married men. Unskilled workers are much more liable to accident than skilled workers. Non-English-speaking employees have twice the rates of those who speak English.

The New Employee.—A very important fact, shown by statistics of accident distribution, is that the new employee is in great hazard from his own ignorance and inexperience With reference to him the National Safety Council says "In all

industries the new men—'green' men—are most frequently injured In a large steel plant the accident records show that men employed less than thirty days were injured six times as frequently as those employed longer, and that those employed less than six months were injured four times as frequently as the remainder." [1] The Procter and Gamble Company finds that over a third of lost-time accidents occur to men who have been employed less than two weeks. The General Electric Company has found that 50 per cent of the accidents occur to employees who have been at their position for less than six months A New England plant found the distribution of accidents among employees who had been in the establishment for less than a year to be as follows One month or less, 275, 1 to 2 months, 80, 2 to 3 months, 71; 3 to 4 months, 46; 4 to 5 months, 31; 5 to 6 months, 50, 6 to 7 months, 25; 7 to 8 months, 25, 8 to 9 months, 12, 9 to 10 months, 20; 10 to 11 months, 8 The record for one month or less includes 26 accidents which happened on the first day of employment and 103 accidents which happened during the first week The inference from such statistics is that the new employee must be kept under close supervision, and must be specifically instructed with reference to each accident hazard pertaining to his job.

The Safety Campaign —The safety campaign of an establishment is something which must be vigorously backed up by the higher officers, so that the conviction spreads from headquarters that the company is in earnest. It is well to have this campaign under the general direction of a safety engineer, or one of the general officers, but the major part of the work with the rank and file must eventually be done by the foremen. It is of the utmost importance, therefore, to enlist the active cooperation of these supervisors.

Shop safety committees of employees should be organized By means of their inspections and recommendations the company can learn of conditions which would otherwise be overlooked. Furthermore, the appointment of an employee upon a shop committee for a term so opens his eyes to the danger of carelessness and ignorance that he becomes an active supporter of the safety movement It may be remarked, in passing, that safety work is one of the very best opportunities an employer will have

[1] The New Employee, Chicago, National Safety Council

for developing committees among his employers, and for accustoming them to work with the management in the interest of the common good.

It is well to have a code of safety rules, and to take opportunity, through the book of rules, and by means of bulletin boards, to make them familiar to all. But such rules will not be self-enforcing. Safety is like production: something which is constantly in the process of being achieved. And, like production, it requires the persistent expenditure of effort, through appropriate organized agencies.

Infection.—The great danger which follows upon the heels of accidents is infection. If medical skill be at hand, first-aid kits should not be put in the shops, as they encourage inadequate treatment. It is estimated that, throughout the country, from 5 to 10 per cent of serious wounds become infected. Infections are a prolific cause of pain, of slow recovery, of permanently stiffened joints, and of amputations. The National Safety Council reports that 10 per cent of all workmen's compensation cases are due to the infection of accident wounds As permanent disability entails large compensation payments, it is profitable, as well as humane, for the employer to give prompt and expert attention to all cuts, bruises, and lacerations, no matter how trivial.

A good record with reference to infections should be below 1 per cent of the cases. A large number of the best-managed industrial medical departments have regular records of $\frac{1}{2}$ of 1 per cent or $\frac{1}{4}$ of 1 per cent, while some have practically no infections at all.

Medical Aid in Industry

Illness and its Economic Results.—It has been estimated that the average wage earner loses from 6 to 9 days a year from his work on account of illness. This means that continuously from 2 to 3 per cent of the average factory personnel is absent on this account. About 20 per cent of these persons, annually, are caught by an illness which keeps them from work for over a week. A large eastern factory recently reported, as a year's record, that 5.65 per cent of the working time had been lost These figures imply that something between a million and a million and a half

of the wage earners are sick each day. The daily loss in wages must be between 5 and 8 million dollars.

When it is realized that approximately one-fourth of those who are sick get no medical attention, that one-third of the sick are trying to continue with their work, that many persons are postponing necessary operations on account of expense, and that the productive time lost on account of sickness is from seven to ten times that lost on account of accidents, the importance of preventive measures and proper medical care is made obvious.

This necessity is reenforced, when the devastating effect of illness upon the wage earner and his family is considered. With the advent of sickness of the wage earner wages cease, all ordinary expenses continue, a group of unusual expenses begins, and savings melt away. Only one-third of the workers has any sickness insurance, apart from what the employer may have taken out as group insurance Many borrow to pay their bills From one-third to one-half of the chattel mortgages placed on furniture and clothing are due to sickness. Others fall upon charity. It is estimated that about 45 per cent of the cases dealt with by public and private charitable agencies are due to breakdowns of health

The pity of ignorance dealing with one of the major disasters of life is revealed in a paragraph from the hand of Mr. Richard A. Feiss. "No one who has ever been in actual touch with the men and women of an industrial organization has failed to run across the case of the man who is down and out because of long sickness in his family. Doctor bills and bills for medicines are rapidly getting him deeper and deeper in debt, or he may be brooding over what he thinks to be the last lingering illness of one of his family. A man with a load such as this can seldom hold up his end in either output or quality. In the vast number of cases an investigation will show that his troubles can easily be alleviated. He is often the prey of an unscrupulous practitioner or some fraudulent fake who is bleeding the family for every cent that it can scrape together. In other cases the family is despairing of medical assistance and is found to be squandering a large portion of its income on fake remedies at the advice of ignorant neighbors or under the influence of the advertising carried in newspapers. The prevalence of these conditions is of such amaz-

ing extent as to cry for public attention. By reason of its far-reaching effect, the handling and prevention of such cases must be considered one of the important accomplishments of the medical service."[1] It is obvious that a new and powerfully efficient agency is needed in this field. The employer who knows of the conditions more intimately than any one else cannot escape responsibility for some sort of response to the situation.

Hygiene and Sanitation.—The A. B. C. of health service is to provide good air and light, proper temperature control, scrupulously clean workrooms, an abundance of cool drinking water, with sanitary cups within easy reach, clean well-ventilated and properly equipped toilets, washing facilities with abundance of soap and clean towels, vermin-proof ventilating lockers, and an attractive and quiet rest room for women employees.

The installation of shower baths is becoming the accepted thing in establishments where the occupation is uncleanly, as in cotton and woolen manufacture, the sorting of rags for paper stock, stone cutting, the grinding and polishing of metals, the handling of wool or hair, and hide cleaning. It is even more important in chemical works where poisonous dust and fumes are generated, or in any manufacture where lead enters as a component, as in the making of paint, pottery, and plumbing supplies, or the manufacture of cut glass.

The Company Doctor.—The introduction of company physicians, and the provision of treatment rooms, nurses' service, and hospital accommodations, either privately or by arrangement with local hospital authorities, has come about for the most part since 1910, but rapidly since 1916. "Safety first" and medical aid have combined to bring into the factory, in the person of the physician, a representative of one of the oldest, and most scientific, of professions.

Among the functions of the physician in industry are the following:

1. The suggestion of improvements in the sanitary equipment of the factory.
2. The study of dusty, wet, hot, or otherwise physically disagreeable jobs.

[1] Personal Relationship as a Basis of Scientific Management, Richard A. Feiss. Revised from Bulletin of the Taylor Society, Nov. 1915, Vol. I, No. 6.

3 Prescription of the points at which respirators, goggles and other forms of protective clothing shall be worn

4 Study of cases of unusual fatigue

5 Physical examination of candidates for employment

6 Reexamination after illness and before transfer to new kinds of work

7 Health supervision of workers who are below par, with re-examination as may be needed

8 Treatment of the sick preliminary prescription or, if not otherwise arranged for, entire care

9 First aid in accident cases and, if not otherwise arranged for, after care

10 Measures to prevent the spread of contagious diseases

11 Formulation of the company health rules

12 Education of workers in hygiene and care of the health

13 Educational work with the families of workers, through the agency of a visiting nurse

14 Control of the plant health records

For plants which are located in large cities the tendency has been to limit plant medical service to physical examinations, emergency treatments, diagnosis, reference of sick persons to the family doctor or to a list of reputable physicians, aid in arranging for and financing operations, and reexamination upon return to work after illness These examinations at return not only determine whether the employee is fit to take up his old task, but they serve as a valuable check upon the competency of the work done by outside physicians, surgeons, and dentists One of the functions of the industrial physician is to protect his personnel against medical quacks.

Plants which are located in small communities, as in the case of a mining company which has its properties in a locality where the only facilities are those provided by the company, will naturally provide a more complete service, taking care of the health not only of workers, but of their families, and maintaining standard hospital facilities.

The Visiting Nurse.—The employment of a visiting nurse is the recognition of two facts first, that the nurse, previously considered as a curative agency only, is being used as an educational and preventive agency; second, that the efficiency of an employee may be quite as much reduced by wrong conditions in the home

as in the factory. "A man who sits up night after night nursing a tuberculous wife or helping to care for children with croup has an increased disposition to error of judgment; he is not a safe man to run an engine"[1]

The visiting nurse or welfare worker may save the life of a child, instruct a mother in the feeding and care of children, detect malingering, reduce absenteeism, supplement the data of the plant physical examination, bring needed aid in unreported cases of illness, inculcate lessons of cleanliness, sobriety and thrift, discourage the boarder and roomer evil, improve the status of women and children in the households of the foreign born, prove to be a friend in time of family disaster, change the entire atmosphere of a household, and win for the employer the unqualified confidence of the worker.

Cost.—Medical aid service, including the service of a physician and nurses, is a reasonable load for an employer whose employees number 500 or more. A large employer in New England, nationally known for the excellence of its medical service, reports that the cost is approximately $3 00 per full-time employee. Where employers in small communities undertake the full round of medical service for employees and their families, the cost will be greater. A coal and iron company, which offers complete service to its 11,000 workers and their families, finds the cost to be approximately $12.00 per year per full-time employee.

Company Housing Activities

Housing is chiefly a village enterprise. If a manufacturing plant is built in the open country, or in a small village, local capital and enterprise may not be adequate, and outside capital may be disinclined to invest in an enterprise depending upon a single corporation. Again, a manufacturer who has developed an industry requiring skilled labor, in a village, may find that the superior workmen and the more ambitious families are being attracted away by the lure of the large city, so that it is necessary to develop a counterbalancing attraction in the village life. As the art of city planning develops, and the "garden city" movement extends

[1] Standardized First Aid, Dr. C A Lauffer Second Annual Report of the National Association of Corporation Schools, New York, 1914, p. 621.

itself, it is becoming evident that the village can successfully develop such attractions, and can hold people of good taste and general intelligence.

Is Housing Activity Desirable?—In favor of housing activity by large employers may be mentioned the likelihood that correctly designed floor plans and adequate specifications will be used. Mr. John Nolen has said that, "A large percentage of all houses are poorly conceived for their purposes." By operating on a large scale, employing only competent persons, paying the lowest rates for the use of money, and foregoing anything in the way of speculative profit on operations, the corporation can furnish a given unit of housing to an employee for less than real estate speculators and commercial builders can do, and for less than the employee can build for himself.

The corporation can secure the services of men who are able to plot land correctly. There is an opportunity to design the street system with reference to larger areas than commercial developers can usually command; and more consideration can be given to aesthetic qualities. The corporation, in developing property, can build with special reference to the needs of its own employees. It can control nuisances; and it can work out an intelligent zoning system for each class of use within its area. By these means a great increase in the utility and beauty of a residential area may be secured.

By company operations on a large scale, rentals may be permanently fixed upon the basis of the original cost plus maintenance charges, so that the payment of large sums by employees to outside land owners, as the charge for unearned increment in land values, may be avoided. The United States Steel Corporation left the housing problem of Gary, Indiana, to private enterprise. "According to a report by Dr Haig to the Committee on New Industrial Towns, the cost of the town site was found to be $7,057,000. The cost of improvements was $4,030,000, making a total of $11,087,000. The value now stands at $33,445,000, an increase of $22,358,000, (over 200 per cent), all of which has been dissipated among private owners and speculators." [1]

The most important results which flow from a wisely planned

[1] The Workman's Home, Leslie H. Allen, Boston. Aberthaw Construction Company, 1918, p. 22.

housing program, to a corporation, are that it draws a superior class of workers, and makes them contented and stable in their relations to it.

The Difficulty of Housing Operations.—The chief impediment to housing activity lies in the fact that, in all cities of large size, in so far at least as plants with close-in location is concerned, the proposition is likely to be too large for any single employer to handle. When the housing of the employees of one firm is bound up with the entire housing problem of a city, and this, in turn, is tied in with issues of zoning, artery construction, local transportation, and city planning, it can be seen that joint action on the part of large groups of interests, with the aid of the local government, is the method of operation clearly indicated.

There is now a recognizable tendency for employers to act in groups in the matter of housing even in localities of small size. At Kenosha, Wisconsin, a local association of manufacturers has been constructing houses through the agency of the Kenosha House Building Company, and the Kenosha Homes Company. At Bridgeport, Connecticut, a Housing Company, whose capital was subscribed by the employers of the city, has done extensive work At Niagara Falls, N Y., an organization of employers loans money on second mortgages, and recommends to each employing corporation what part it should play each year in the general program of house construction.

Rents and Building Costs.—The particular budget for wage earners which was often advised by Mr Jacob G. Schmidlapp, Cincinnati's landlord philanthropist, runs as follows:

> One day's wage for one week's rent.
> Two days' wage for one week's food
> One day's wage for one week's clothing
> One day's wage for all extras, including fuel.
> One day's wage for profit and pleasure

Unfortunately, the landlord is no longer satisfied with such a distribution of expenditures. The rules now utilized in housing calculations are that 25 per cent of the wage earner's income, or one week's wages per month, is to be paid out for rent; and that annual rents must be approximately 10 per cent of the cost of the property. The average weekly earnings of men in New York state factories

were, at the beginning of 1925, $31 38 In Massachusetts they were $28 57 The wages of skilled men in factories, in favored trades, may be placed at from $35 00 to $50 00 a week Applying the two rules above suggested we get the following results

WEEKLY WAGES (Monthly Rental)	ANNUAL RENTAL (12×Wages)	VALUE OF PROPERTY (10×Rental)
$25 00	$300 00	$3000 00
30 00	360 00	3600 00
35 00	420 00	4200 00
40 00	480 00	4800 00

For workers with wages above $10 00 a week, the housing problem is not difficult But for those who are below that figure, the problem of constructing, at present prices, a self-contained single-family house, with reasonable sanitary equipment, to be paid for by a series of installments, is on the edge of being impossible. Below that rate of earning, the problem begins to assume the aspect of a permanent rental proposition As earnings fall below $30 00 per week, the prospect of being able to rent a standard self-contained, one-family, five-room house begins to fade.

The United States Bureau of Labor Statistics recommended, in its quantity survey for a " health and decency " standard of living, that the house of the wage earner should contain from 560 to 660 square feet of floor space Very moderate building costs in residence construction are now considered to be 30 cents and 35 cents per cubic foot Using these bases, we can construct a table of possibilities as follows

NET FLOOR SPACE, Sq Ft.	CUBAGE, (Approx) Cu Ft	COST, House at 30 Cents Lot, $500	COST, House at 35 Cents Lot, $500	RENTAL, Monthly (30 Cents) Etc	RENTAL, Monthly (35 Cents), Etc.
560	8370	$3011	$3430	$25 09	$28 59
660	9835	3450	3942	28 75	32 85

By comparing the rentals called for in this table with the rentals assumed to be possible at various wage rates given in the previous tabulation, an idea can be formed of the surplus, if any, which will be available in the wage earner's budget for payments, over and above rent, to apply toward the purchase of a home.

The great bulk of the wage-earning population is, of course, housed in quarters constructed before the high building costs of the present prevailed. These quarters are now in all stages of disrepair and obsolescence. For such accommodations, rents are probably not seriously out of line with the general movement in the cost of living. It is the high cost of new construction which is making the rent problem emerge, by demanding a larger proportion of the wage earner's income to satisfy the landlord.

The situation may best be seen in the bird's-eye view, by considering the relative movement of a variety of index numbers.

DATE	WHOLESALE PRICES. DUN'S INDEX NUMBER	MONEY WAGES, AVERAGE NEW YORK STATE FACTORIES	COST OF LIVING, U. S BUREAU LABOR STATISTICS	COST OF BUILDING MATERIAL	COST OF LABOR, BUILDING TRADES	COST OF NEW CONSTRUCTION (TOTAL)
Year, 1913	100	100	100	100	100	100
Mar , 1921	150 5	221	180 4[1]	173	195	182
Mar , 1922	140 4	201	166 9	155	179	165
Mar , 1923 .	158 2	221	168 8	198	189	194
Mar , 1924	157 8	231	170 4	182	214	195
Mar , 1925	167	233	172 5[2]	180	217	197

Types of Construction.—The average company which has done something in the housing field has provided accommodations for approximately one-third of its employees In doing so it has erected houses 90 per cent of which are frame About one-half

[1] Figure given is for May, 1921 No figure is available for March, 1921

[2] Figure given is for December, 1924. No figure is available for March, 1925.

of the houses are detached, single-family houses; while one-third are semi-detached or double houses with one partition wall between two families In construction programs, the leading emphasis is placed upon the attainment of a single-family, detached house or cottage as the ideal thing. As Mr Schmidlapp says, " The best house for the wage earner is the same as the best house for yourself, and that is the individual house " Multiple houses, in some attractive form as " terraces " and apartments must increasingly play a rôle in providing accommodations for that half of the industrial population which may be classed as unskilled Barracks and bunk houses are to be avoided as permanent habitations They attract only an undesirable and unprofitable type of laborers.

The points which mark " aristocracy " in working class homes are possession of an inside toilet, possession of a bathtub (both connected with running water and city sewer), heating by furnace in the basement rather than by stoves in the rooms, possession of a sink in the kitchen with running water and sewer connection, possession of a veranda, and possession of three general rooms rather than two (living room or parlor, dining-room or combined dining- and living room, kitchen or combined kitchen and dining-room). Three-fifths of individual wage-earner's houses have inside closets One-half of all houses, individual or multiple, have baths.

The Roomer.—The problem of the single male worker, who does not live at home with his parents, still stands as an unsolved one The better class of such men patronize the boarding houses. The vast majority, especially of foreign birth, are boarders and roomers in the households of other wage earners. The hostility of the Ford Motor Company to the boarder and roomer evil is well known. The Company's booklet " Helpful Hints and Advice to Employes," says: " Employes should not sacrifice their family rights, pleasures, and comforts, by filling the house with roomers and boarders, nor endanger their children's morals or welfare by allowing them to associate with people about whom they know little or nothing."

Rent or Sell.—Whether the policy shall be to rent, and so retain the landlord's power of supervision, or to sell and encourage thrift, depends not only upon financial status, but upon the ability of the labor class concerned to maintain decent conditions for them-

selves. In the main, unskilled labor will do better with the supervision of an intelligent landlord. Skilled workers, of proved enterprise, will respond with most enthusiasm to plans for achieving home ownership. Garden cities will not long remain such unless the companies providing them retain considerable general supervision.

The building of houses to sell is the suitable plan in cases where housing is constructed along the usual lines of village residential development, without aiming at a special aesthetic effect or a community development, and is intended for skilled workers, office workers, and foremen. The problem in such cases is, in reality, a three-part problem of financing; first, to attain low cost construction, second, to give possession upon the making of a small initial payment, third, to arrange over a series of years a scale of payments which will extinguish the loans. The Dennison Manufacturing Company of South Framingham, Mass , and the Eastman Kodak Company of Rochester, N. Y , assist the prospective buyer, who is able to pay down 10 per cent of the purchase price, by helping him to arrange a loan on the security of a first mortgage, to the extent of 60 or 70 per cent of the value, with a bank or building and loan association. The company then completes the transaction by taking a second mortgage for the remaining 20 or 30 per cent of the value.

The arrangement of a scale of payments for the amortization of the loans presents difficulties. As building costs have advanced, interest charges and local taxes have so increased their demands upon the wage earner, that little money can be spared to reduce the principal of his indebtedness. If the amortization period is lengthened, to make the annual payments smaller, it is necessary to resort to more expensive types of construction, so that depreciation will not outrun amortization. But by doing this the higher initial costs increase the interest charges

When a company prepares desirable housing, and rents or sells it at a price below the market price, it becomes necessary to take steps to confine the advantage to the company's own employees. The Goodyear Tire and Rubber Company, at Akron, Ohio, sells houses to its employees at a price which represents the net cost of the improved land and buildings, plus 25 per cent. This 25 per cent is returned or rebated in five years to the purchasers if they

are at that time in the employ of the company. It is not uncommon for companies which sell houses to retain an option to repurchase, the option will be exercised if the employee desires to dispose of his property.

PROBLEMS

Responsibility for Accident.—In the yard of a certain manufacturing establishment, at a point where a clearance between railway track and wall was too small for a man to stand safely, there was located an outlet for water It was intended for no other purpose than the flushing of an adjoining gutter, and the men were forbidden to get supplies from it In spite of the order it was used from time to time, because of its more convenient location, instead of the more distant faucet provided Finally a man was caught and killed Who was to blame? Should the officers of the corporation have done anything further or anything different from what they did do, if so, what?

The Limits of Compensation.—There are many accidents each year to employees, which can be classified under each of the entries given below Each of these accidents entails a loss of employment and other expenses In which cases would you place the burden of the expense upon the employer, by means of workmen's compensation laws?

1 Street accidents

2 Accidents while going to and from work

3. Injuries due to scuffling, larking and horseplay

4 Accidents, as sometimes stated in legal textbooks, caused by the act of God or the country's enemies.

5 Injuries arising out of attempted robbery, fighting, assault, murder or suicide

6 Disabilities due to frostbite or heat stroke

7 Accidents occurring during moments of leisure or while doing something of a personal nature, or out of curiosity.

8 Camp accidents, as in lumber camps or construction camps

9 Accidents resulting in the aggravation of a preexisting diseased condition, or extraordinary conditions amounting almost to accident, resulting in disease, as pneumonia caused by exposure

10 Accidents due to disobedience of rules.

11 Hernia, lumbago, and strain cases

Modes of Recovery and Recovery Period.—A workman in a foundry developed a hernia The company doctor made an examination and advised him to submit to an operation, telling him that in the average case persons operated upon for hernia made a rapid recovery, and were

able to return to work in about 41 days. The man, however, refused to be operated on. It is obviously unfair to compel an employer or his insurance company to pay workmen's compensation indefinitely; and it is impossible to compel the workman to submit to an operation. What should be the nature of the state law drafted to cover such cases?

The Scale of Benefits in Workmen's Compensation.—It has been said of state compensation legislation, "Most of the States compensate permanent injuries on the basis of a fixed scale of benefits. These scales are not based upon scientific information and are not designed to compensate fully for the loss of a member of the body Even if a scale giving full compensation were attempted, we would not know how to construct it, because we have not been farsighted enough to study the actual results of the various permanent disabilities. Not only are we ignorant of the wage impairment of specific injuries, but we do not even know, except as common sense may dictate, the relative significance of the various kinds of injuries."

Compile in parallel columns the compensation scale of your state and of two or three neighboring states Point out the differences between them, and suggest a plan by which a fairly accurate scale might be constructed to match compensation to the seriousness of various types of injuries to the persons injured

The Distribution of Industrial Accidents.—If permission can be obtained from a local manufacturer, and if statistical records can be found sufficient to permit it, make a study of the accidents of a year in a factory, showing whatever may be significant as to distribution by individuals, by shops, by work processes, by length of time the individual was employed, by hours of the day, etc. Digest these statistics, interpret them, and make graphic charts to bring out the chief matters.

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CHAPTER XXIII

OFFICE DEPARTMENTS

The office of an industrial organization may be likened to the central nervous system of the human body It is a sort of stock room for ideas Its functions revolve around the reception of ideas, the classification and storage of ideas, and the issue or dissemination of ideas All of these functions demand the written record The office is busied with the functions of receiving and inspecting reports, of receiving and sending correspondence, of transcribing, computing, tabulating, and otherwise reworking data, and of classifying and filing documents for future reference

In the lower grades of office work there is much performance of a clerical order, such as the converting of one form of record into another, the comparison of records to detect points of similarity or difference, the separating, classifying, sorting, and combining of the data of records, and the performance of simple arithmetical computations

Equipment.—The modern office has grown up in a world which freely uses the mail, the telegraph, the telephone, the typewriter, stenography, the unit record, the half-tone cut, the photograph, the blue print, the catalog, and the bank check The beginning of the evolution of mechanism for the modern office may perhaps be dated from the time when Thomas Jefferson brought back from England with him a swivel chair and a letter press and copy book. Among the chief mechanisms which now serve the purpose of office work may be mentioned the typewriter, introduced shortly after the Centennial Exposition of 1876 to banish the old-time amanuensis, the unit-built filing cabinet. the vertical filing cabinet for flat filing, and the fountain pen.

The clerk's desk is as ubiquitous as the operative's machine, but has been more persistently misunderstood At various times

in the past the office desk has been looked upon as a piece of ornamental furniture, as a warehouse for storing records, and as a safe or closet for locking up "matters pending" from the eyes of others. It is primarily none of these things, but a modified work bench, to facilitate the onward movement of documents rather than their storage or seclusion. A few years ago desks abounded in drawers and pigeon-holes which yawned on all sides to swallow up documents and facilitate their delay. And these desks were barricaded on all sides with partitions raised above the working plane in such a manner as to screen the occupant from general supervision The introduction of filing cases and of efficient filing systems has drawn most of the records out of private desks, and concentrated them where they are accessible to all. The desk is now solely to expedite current business: to pigeon-hole a thing has become equivalent to neglecting it.

The unit record of standard size occupies the same position in record keeping that the interchangeable part does in the world of machinery The first system of unit records to come into general use was the card catalog of library science. This form of catalog was first used extensively in American public libraries. The system of unit records, now having so many applications in business offices, has the advantage of permitting the concurrent use of various portions of the record—the different drawers, for example—by a number of people It facilitates the introduction of new records, and the removal of obsolete matter, without interrupting the use of the live material. By the utilization of various systems of indexing—alphabetical, topical, chronological, and geographical—facts may be made almost instantly accessible, whatever the angle of approach. By the use of cross references, as many avenues through the records may be opened as are desired.

The value of permanent records is obvious, the value of uniformity in reporting the same matters in similar cases is also obvious. Forms exert an important influence in the direction of securing uniform reports. By setting aside specific spaces for specific facts there are created reminders which will stand as blocks of blank white paper staring at the reporter until they are filled. If a report form is prepared and printed in advance, the writing required of the reporter may be reduced to a minimum by printing all the permanent parts of the record. By this means the

practical range of report writing may be much extended into shop and field. Furthermore, printed reports may be made so compact and legible, and so portable, that the facts they contain are given greatly increased time and place utility.

It must be considered whether a form as drafted will fit the typewriters, if it is to be typewritten, and whether it will fit the files, if it is to be filed. If a form is intended for field work, it should be compact enough to fit a coat pocket or hip pocket. If unit records conform to the sizes adopted by the stationery trade as standard, it will be possible at all times to secure accurately cut paper, cartons, trays, folders, guide cards, binders, drawers, and cabinets, at moderate prices. The principal sizes are 3×5, 4×6, 5×8, $8\frac{1}{2} \times 11$, $8\frac{1}{2} \times 14$, and 11×17 inches.

The Arrangement of Office Departments.—The first step in determining the space required for office departments is to ascertain, by methods analogous with those used by scientific management in the shop, how much an employee should be expected to do in a day. The experience of office managers now indicates in a general way what this is. It is held, for example, that in an hour 200 letters can be opened and read sufficiently to determine the department to which they should be referred, that 200 orders of five items each can be entered in an order register, that 100 square inches of typewritten work can be accomplished by a girl of average ability, and that 2800 items can be handled on an adding machine.

The next step is to determine the various kinds of work which will have to be performed, and the amount of each, thus giving a criterion as to the number of persons required. The third step is to calculate the space requirements, the general rule being that office space runs from 60 to 90 square feet of floor space per employee, including allowance for aisles and furniture.

In making a layout the office area should be conceived as something to be divided into a series of work places, each devoted to a function which sustains given relations to certain other functions. Those individuals in an office who have most communication with others should be on the aisles. Departments having much to do with each other should be near neighbors. The progress of work should be as simple and straightforward as possible. It is well to integrate departments, bringing officers and their staffs together

There is a tendency to do away with partitions, or make them of glass above desk height; leaving private offices for the highest officials only, together with a few small rooms for personal transactions and conferences. The remaining space is left as one large room, properly subdivided by low railings. Such an arrangement gives good light and ventilation, absorbs sound well, works an economy of space, and provides a wholesome publicity which is in the interest of discipline and application

The Personnel.—It has been pointed out that between 1910 and 1920 the general population of the United States increased 15 per cent, and the persons in all gainful occupations, excepting agriculture, increased 20 per cent, while the number of persons classified as clerks and office workers increased nearly 100 per cent In ordinary practice the number of persons in the office force will average about one to twenty of the shop or field force. The payroll will be in the neighborhood of $1.00 to $10.00 of the other departments

Where the number of stenographers exceeds ten, and where there is a head stenographer who is able to arbitrate skillfully between the claims of specialization and the demands of the general schedule of work, the system of a centralized stenographic department is growing in favor. Such a system permits the averaging out of the fluctuations of the work of individuals and departments, so that a more uniform daily program of work is possible for all, and the work is better equalized as between individuals. By this plan work is not held over, owing to the absence of any individual stenographer. The centralized stenographic department is a good training school for new stenographers, and it produces an all-round stenographer. Such a central staff involves a very considerable saving of time and salaries, makes possible a program of promotions, facilitates the equalization of wages, provides more definite standards, discourages idling and incompetence shielded by "personal influence," and makes easier the decrease or increase of the staff according to the total demands of the office. It also adjusts itself to the rapidly growing practice of phonographic dictation

The Preparation of Correspondence.—The duties of a correspondence officer have been thus defined· "The correspondent answers incoming mail. He collects details needed from other

departments or from past correspondence and dictates replies. His work requires knowledge of his company's product, policies, and of modern business methods. He should have a good vocabulary and be able to dictate a good letter easily—a letter that is clear, correct, and courteous. He should have an insight into human nature, combined with ambition, reason, and ability, and should be of optimistic turn of mind. . . . He must know how to figure prices from the catalogue, handle a complex adjustment, state the company's policy on various matters, confirm or seek information as to the manufacturing details of an order, follow up with customers all balances which have been questioned, and cover many other points which occur in the day's mail." [1]

The correspondent is guided in his work by a supervisor of correspondents who will make test runs through the outgoing letters from time to time, grading them as a college instructor of English would grade a batch of Freshman essays. On the basis of such investigation, he is able to give efficient coaching. There is also provided, in the larger offices, a manual or a series of manuals, on the art of writing good letters.

The mass of correspondence which is now handled by the larger private corporations and by the departments of the United States Government, and the consequent expense which such correspondence entails, has forced the consideration of every possible means of abbreviation.

One means by which a great economy of time and effort may be achieved in correspondence is to employ a series of standard paragraphs covering the subjects which occur most frequently. A full equipment of such paragraphs for a business may involve from 200 to 500. These paragraphs can be prepared by committees, and can achieve a standard of clearness and brevity far beyond the extempore work of individual correspondents. Each paragraph is given a mnemonic symbol. A full set of paragraphs, with an index, should be in the possession of each correspondent, stenographer and typist. Answers to letters may then be indicated by simply noting the symbols of the required paragraphs. Original matter may be interspersed between standard paragraphs as desired; and paragraphs can be constructed with blanks for the insertion of a name, a date, a place, or other matter which will

[1] Practical Experience In Office Management, Bureau of Commercial and Industrial Affairs, Boston Chamber of Commerce, Boston, 1921, pp 8 and 39.

give an individual touch. Standard paragraphs serve as a sort of intermediate resource between personal dictation and "form letters." Several paragraphs may be prepared expressing the same idea, so that distinctions as to fullness and tone can be made.

The next step beyond the form paragraph is the form letter. A series of form letters may be produced in quantity by some economical means of duplication, and held ready for the insertion of name and address, and other special material, by the typist. The final step in economy is a printed form letter composed of a series of numbered standard paragraphs, so chosen as to cover all the more customary forms of reply necessary to make by mail to outside parties. Such a form is ready for mailing when the correspondent has put a check mark in front of the paragraphs which apply to the particular case.

Methods of Dictation.—There are two methods of dictation: the stenographic and the phonographic. The phonographic method of dictation upon wax cylinders, from which typing is done in the typing department, has many advantages. "The difference between stenographic and phonographic dictation is radical. The usual practice, by the former method, is for the dictator to take a succession of cases, go over them, prepare in each case the reply he intends to make, then call the stenographer, and begin the dictation By this time the dictator has in his mind some 20 to 30 replies; but he has read so many letters and consulted so many papers in connection with them, that he must lose more or less time in recalling important points and in reviewing the papers. It is not unreasonable to state that from 5 to 10 per cent of the dictator's time is lost. The stenographer sits idly by, while review work is being done.

"By the use of the dictation machine, no time is lost in reading papers or files the second time. The machine being near the desk of the dictator, as each case is prepared in the first place the reply is dictated and disposed of. The result is a letter prepared fresh from the mind of the dictator, whereas by the stenographic method the letter is dictated a considerable time after preparation and must necessarily suffer, both in direct application to the case as well as in diction." [1]

[1] Economy and Efficiency in the Government Service, Washington, D C, 1912 Report of Committee on Economy and Efficiency, 62nd Congress, 2 Sess H. R. Doc 670, pp 536–537.

Filing.—The modern filing system is based upon the process of vertical flat filing, in unit filing cabinets of a central file, of all material that is worth preserving, of original incoming correspondence and documents, and of copies of outgoing correspondence and documents, under a comprehensive system of classification, by the rules of which there can be but one logical place for each item. The difficulty of filing is to make the boundaries of classes absolutely distinctive, so that there can be no instances of doubtful destination No one should have access to the files but employees of the filing department. The chief file clerk will assign to each girl a section of the files, and she alone should work in that section.

The Office Schedule.—The scheduling of stenographers presents something of a problem. A very simple and efficient plan is thus described by Mr John Barnaby "It is necessary for the head stenographer to know at all times how much work each operator has ahead of her, so that when she receives a call for stenographic service she will not have to take the time to ask the individual operators how soon they will finish the work in hand.

"The head stenographer takes a sheet ruled to show the hours of the day and divides the hour either into six columns representing ten minutes each or four columns representing fifteen minutes On the left side of the sheet she lists the stenographers and shows the time it takes each individual to write out one page of her notes This figure does not represent the best possible time but the time the operator takes normally.

"When a stenographer comes back to the stenographic department after taking dictation, she lays on the head stenographer's desk a slip of paper showing the time of her return and the number of pages of notes to be transcribed The head stenographer multiplies the number of pages by the minutes per page which appear on the layout sheet In this way she arrives at the time it will take for that individual to complete the work in her book. The head stenographer draws a line on the layout sheet representing this amount of time, beginning at the time noted on the slip of paper which the stenographer has placed on her desk When this has been done for all the operators in the department, the head stenographer can see at a glance from her layout sheet when each stenographer will complete her work.

"When a dictator calls for a stenographer, she looks to see if the one who is in the habit of handling the man's work can take this dictation and get it out that day. If not, the head stenographer sends to the dictator the one who will first be available. If the capacity of the whole stenographic department is taken up for the day and a dictator calls for a stenographer, the head stenographer will then tell him that it is impossible to get out any more work that day unless he prefers to have left over until the next day some of the letters he has already dictated."[1]

To complete this system of control, the head stenographer should notify any dictator who calls for a stenographer in afternoon hours,—when a question is likely to arise as to whether the dictation about to be given can be transcribed before the close of the day—how many pages of shorthand notes the stenographer assigned can handle before closing time. If the dictation exceeds this quantity, it should be given with the understanding that transcription will take place on the next day. Otherwise, a second stenographer should be summoned to take the surplus quantity.

Office Instructions.—In office work it is out of the question to issue instruction cards, such as control the individual jobs in the factory. The instruction of clerical workers takes the form of permanent and standing orders. These orders should be gathered together, harmonized, completed, and then promulgated as the book of standard office practice. Such a manual is of the utmost importance. It serves as the text book of all new employees, facilitates and directs cooperation between officers and departments, and acts as a guide in salary adjustments by revealing the character of the duties performed by each person.

The Problem of Attention.—In the shops and in field work, where productive processes of a physical nature are going on, the progress of work is accompanied by the movement of certain objects, and by a characteristic succession of sounds. In the successive stages of a task the workman's body assumes different postures and his hands come in contact with different objects. A varied stream of sense impressions, therefore, pours in upon the workman's brain, and assists him to keep his mind fixed upon his task. And if his attention wanders, a change in some one of the

[1] Management's Handbook, L P Alford, Editor, N Y., 1924. Ronald Press Section 7, Office Management, John Barnaby, pp 420–421.

physical conditions presently recalls it, and gives to the returning thought a prompt grasp of the state of affairs.

The labor of office work, on the other hand, must be carried on without these powerful aids to attention. It deals with a flow of ideas more or less completely embalmed in a monotonous collection of written or printed papers. The accompanying physical process is an exceedingly subordinate matter: it is uniform and deadening, and lacks that dramatic and attention-arresting character which physical labor possesses. Most of the sense stimuli received by office workers from sounds and moving objects tend rather to draw the attention away from the task, than concentrate upon it. To hold the attention against the pull of interest requires an effort of will.

"The modern business man," says President W. D. Scott, "is exhausted no more by his actual achievements than by the things which he is compelled to resist doing

"He is inefficient, not through lack of industry, but from lack of opportunity or of ability to concentrate his energy upon the single task at hand." [1]

The aim is, therefore, to defend office workers against distractions, by suppressing useless noises, by shutting out the sight of moving objects, by eliminating glare and, in general, by blocking the various by-paths down which attention may wander as a truant.

The problem of noise is growing in importance. The increase of city congestion, the greater number and speed of vehicles, the paving of roadways with hard resounding substances, and the walling-in of the streets with lofty buildings whose fronts reflect sound as do the sides of a cañon, have conspired in recent years to make conditions in office sections distinctly less favorable to mental concentration. The inside conditions have also grown worse. As Dean W. C. Sabin of Harvard University, the leading American expert on acoustics, has said, "The whole development of building construction and building materials, during the past twenty-five years, has been in the direction of poor acoustics and more and more noisy offices. Recent efforts at fireproof construction have resulted in the use of harder and harder wall surfaces, with consequent increase in reverberation The plaster, too, is usually

[1] Increasing Human Efficiency in Business, W D. Scott, N. Y, 1911. Macmillan, Chapter IV, Concentration

applied directly to the tile or brick walls, and is much heavier and denser than the old hair-lime-mortar plaster. As a result we have exceedingly noisy rooms."

Among the remedies for noise are, heavy building construction, tight windows (forced ventilation being used), floor coverings of rubber or cork or carpet, and sound-absorbing coverings for walls and ceiling. Dean Sabin has shown that a layer of hair felt $1\frac{1}{4}$ inches thick, placed on walls and ceiling, will absorb about $\frac{1}{4}$ of the sound of lower C reflected against it, about $\frac{4}{10}$ of the sound of middle C, and over $\frac{2}{3}$ of higher C.

Problems

The Layout of an Office.—In the light of the considerations advanced in the text, under the paragraph heading "The arrangement of office departments," lay out a general office for an establishment of moderate size A corner room in a fireproof sprinklered office building has been secured which has light from intersecting streets on two adjacent sides, while the other two sides are partition walls. The room is 50×75 ft. in size. A door from the general hallway of the building opens at a point near the center of the 50-foot partition wall The owner of the building will construct within this room, light room partitions or railings as may be desired. There is wanted 4 small private offices or conference rooms, a correspondence department with space for 12 typists at desks 30×42 ins, an open office with space for 6 desks 36×60 ins, a filing department with space for 30 filing cabinets each of which occupies floor space approximately 13×24 ins, together with sorting tables There must be provided a stock room, a reception room with information desk, and space for 35 lockers If there is any room left for expansion it should be reasonably divided between the departments The floor plan should meet these requirements as nearly as possible, should segregate noise, give the best light where light is most needed, and provide short routes for visitors coming and going.

Measurement of Stenographic Work.—There is in an office a force of 20 stenographers doing a similar kind of work. From their numbers are selected, from time to time, the women who are put upon technical work, and those who are advanced to minor executive responsibility as private secretaries At present these stenographers receive the same wages per week, although it is realized that they are of different value The selection for promotion is made, partly on the basis of length of service, and partly on general impressions as to capacity, regularity, willingness, etc. It is desired to secure an accurate record of the service

of these persons, so that they may be paid according to performance, so that promotion may be on the basis of merit, and so that, if there are any misplaced individuals among them, they may be transferred to other departments. What information should be compiled, and by what sort of a system or technique will it be gathered and made available?

The Elliott-Fisher Billing Machine.—As an illustration of modern mechanism for simplifying office work, study the mechanism and operation of the Elliott-Fisher Billing Machine and, if possible to secure the loan of a machine, demonstrate the same. The Elliott-Fisher Company is located in Harrisburg, Pa , and has agents throughout the country.

Analysis of Correspondence.—Secure from the university offices, or from a local business concern, the loan of 20 letters, which have been received in the ordinary course of business, and which have originated with representatives of companies of standing With these letters secure such information concerning the circumstances which led to each of them that its object will be understood

Submit these letters to careful criticism and make a report as to the defects or inadequacies discovered. Consider not only appearance, arrangement, paragraphing, grammar, and the like, but clearness, freshness, vigor, adequacy, fullness of treatment, courtesy, and the general atmosphere created

The Unit System.—Report upon the fundamental principles of the Unit System of headquarters administration in its relation to office organization, which was devised by Maj Chas D Hine, and introduced in the Union Pacific and Southern Pacific Railways systems.

Reference—Chas D Hine, Modern Organization, An Exposition of the Unit System, N Y , 1912 Eng Mag Co

Office Forms.—Secure a number of office forms and submit them to criticism, using the critical process described by Mr W H Leffingwell in The Application of the Principles of Scientific Management to the Office, Bulletin of the Taylor Society, Vol. 7, No. 1, Feb , 1922, p 15.

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CHAPTER XXIV

THE MANUFACTURER'S SELLING SYSTEM

"One of the things borne in on us by the business studies and statistical researches of recent years," says Professor F. W. Taussig, "is that the process of getting goods from manufacturer and grower to consumer is extremely costly. The spread between the price received by the prime producer and that paid by the consumer is astonishingly large." [1] The dominant characteristic of the modern distributive system is that, whereas competition in it enforces a fair degree of efficiency upon each individual and corporation, it compels, for the system as a whole, the maintenance and progressive elaboration of an atrocious chaos of duplication and useless expense.

In the measure that the manufacturer is forced to come out from behind the shelter of such merchandising representatives as the commission houses and manufacturer's agents, and take an active part in the marketing of his product, he is obliged to make thorough studies of market conditions, on the basis of which to construct a budget of probable sales which will tie in with his manufacturing and financing budgets, and to elaborate the agencies and plans for attaining the sales quotas thus decided upon. With reference to the contract of sale, it will be necessary to determine what warranties shall be given, when title is to pass, what tolerance as to quantity, quality, or time of delivery is to be specified, and what attitude is to be taken toward cancellation of orders and

[1] Price Maintenance, F W Taussig American Economic Review Supplement, March, 1916, p 181 See further, Report on Relation between Wages and Production, prepared for District Council No. 44, International Association of Machinists, July, 1921, by the Labor Bureau, Inc., N Y C. Based upon statistics and data of Leo Wolman, Paul Douglass and Professors W. F. Ogburn, H R Seager, W C Mitchell, E. E Day, and Walter W Stewart Republished in Principles of Wage Settlement, Herbert Feis, N. Y., 1924. H. W Wilson Co., pp 402–423.

unjustifiable return of goods. There will be many price questions concerning standard price levels, bulk prices, quantity prices, price differentials to protect different classes of dealers, price guarantees, as well as the attitude to be taken toward the prices of resale employed by dealers.

The selling department will have much to say about the factory product, especially as to finish and the style of packaging. It will be necessary to control such active agencies of sale as traveling salesmen, branch agencies, and, perhaps also, retail stores. A variety of services must be rendered to dealers and consumers: while, at the same time, an advertising campaign is conducted through a variety of avenues, to influence public opinion favorably.

All of these activities are very different from the marshaling of machinery, men, and materials in the manufacturing process, so that it will be necessary to construct, within the business, a major administrative subdivision, with appropriate personnel of officers and employees, to have charge of them.

The Marketing Department.—The chief executive of the marketing department,—who is still usually called the sales manager—should be coordinate with the works manager, and under the supervision of the general manager. The general tendency is to recognize the growing importance of marketing functions by elevating the sales manager to a position of greater prominence in the executive hierarchy of his corporation He is now to be considered as one of the leading functional executives in full charge of all selling and advertising activities, and operating under the supervision of the general adminstration, on a plane of equality with those executives who are responsible for production. This implies the unification of the control of selling and advertising, as sections of a comprehensive marketing process

The object of elevating the sales manager, administratively, is not only to unify all activities having to do with marketing, and to secure a higher grade of research and control policies, but to bring marketing plans into more intimate contact with manufacturing and financing plans, at all stages in their development. Close contacts are essential in preparing advance marketing schedules, in order that they may coordinate with manufacturing and financing schedules as parts of the master budget promulgated by the general management. The sales manager will exert a strong

influence upon factory authorities as to the nature of the product, the range of sizes and styles to be made, the trade assortments or seasonal indents to be aimed at, the location of warehouses, and the extent of reserve stocks to be carried at different seasons. He will have much to say as to the operation of branch offices, and as to shipping, credits, and collections On the other hand, he will need information and guidance from the manufacturing and financing divisions as to the costs of products of different character, the costs of standard run versus special order products, the schedules of sales required to permit steady manufacturing operations, the law of costs in terms of different percentages of manufacturing capacity employed, the charges for interest, depreciation, and obsolescence incident to storing products, the limits of the capacity of the corporation for carrying dealer accounts, etc.

The sales manager should learn of any points of interest regarding the qualities of raw material used, the manufacturing processes employed, the safeguards of inspection, or any features of design or finish which are considered to be unique, to the end that the salesmen may better present their case, and better analyze the conditions under which the company's product will give satisfaction, and that the advertising can be written with freshness and convincing point.

Sales Research.—The pressure of competition is requiring an increasingly thorough study of the factors which determine the success or failure of a marketing program. It is a basic rule of efficiency in selling to know thoroughly the properties of goods and the needs of people Misfit sales may be forced for a time, by high-pressure salesmanship and misleading publicity, but they will not maintain themselves, for each sale installs in the possession of the buyer an article which begins at once to educate him as to the error he made in acquiring it Thus a force of negative advertising and negative salesmanship comes into existence in the community which automatically limits the enterprise.

Product Analysis.—The sales manager will desire to study the product of his corporation with reference to economy, efficiency, durability, convenience, simplicity in operation, ease of installation, attractiveness of appearance, compactness, ease of making repairs, character of container or trade package, comparison with rival products, defects revealed by customer's correspondence or

reported by dealers to salesmen, reports of technical investigations, etc He will consider the possibility of making changes in the product, or of substituting for certain numbers new articles, made from like materials, or by like processes, and which have a better mercantile outlook.

Product analysis cannot be completed without the study of consumer's needs. And this is not the same thing as the study of markets. The analysis of the market shows what sells: the analysis of consumer's need shows what might be sold. The important thing left out in market analysis is what the customer needs, and wants, or might be educated to want, which is better than anything now on the market. What this better thing is, can only be discovered by close, sympathetic observation of the activities of life, as they impinge upon the world of mercantile commodities

It takes inspiration to make such an analysis of a product, from the point of view of the consumer's need, as Miss Marion F Lansing made of toys, but such inspiration would be a wonderful aid to many lines of industry. Miss Lansing's study of the Christmas toy was published in the Ladies Home Journal of December, 1916. It is as follows.

"Remember—
That play is the child's business in life, and toys are his tools
Therefore—
Choose toys to do things with, that make him the actor, not the spectator.

"Remember—
That his instinct is to imitate
Therefore—
Choose toys with which he can reproduce in miniature the life that he sees

"Remember—
That his instinct is to create.
Therefore—
Choose toys which lend themselves to a variety of constructive uses

"Remember—
That his instinct is to be active
Therefore—
Choose toys that encourage muscular effort and stimulate his powers.

"Remember—
That his instinct is to repeat.
Therefore—
Choose toys that will stand hard wear
"Remember—
That his instinct is to admire
Therefore—
Choose toys that are artistic
"Remember—
That toys are only pegs on which the child hangs the rich mantle of his imagination
Therefore—
Be more concerned over their adaptability than over their expensiveness, have more regard for their quality than for their quantity"[1]

In connection with product analysis, attention should be given to the possibility of improving efficiency by standardizing the output upon a smaller range of products or sizes or styles or colors or packages. The natural instinct of the merchant to accede to the demands of customers often leads to unjustifiable catering to whims and notions which are of no essential significance. Such a tendency requires to be corrected by a knowledge of the unfavorable operation of the law of costs in small-lot manufacturing, and in the warehousing of slow-moving stocks

Market Analysis.—The market analysis made by the sales manager will involve a detailed study of the territory commercially tributary The population of each city and village will be ascertained and classified, and its potential patronage estimated The total consumption of the products under consideration will be obtained as accurately as possible These figures will be brought into comparison with the shipments made by the corporation to each locality, to show the percentage of product saturation by localities The dealers who are potential buyers will be listed by localities, from trade directories, telephone directories, etc., and compared with a list of dealers to whom sales are being made, to show the percentage of dealer saturation by localities. It will cast a vivid light upon the character of the work done by salesmen, if these statistics are plotted upon maps.

[1] Published with the consent of Miss Marion F Lansing, and of the Ladies Home Journal

Possible new uses of the product, and possible new classes of customers will be considered. Estimates of the capacity of the market to absorb merchandise must be revised with reference to the temporary state of business. The prevailing temper of the trade can be ascertained from salesmen's reports, correspondence with customers, crop statistics, crop prices, building permits, the statistics of failures by industries, checks cashed by Federal Reserve banks, retail sales, as well as from the reports of financial services. The condition of the dominant industries in the territory must be given special attention.

When trade papers, the reports of trade associations, government census records, and other available sources of information have been exhausted, it may be necessary to resort to correspondence, to the compilation of data from questionnaires, to visits to dealers, and even to house-to-house interviews and demonstrations, in order to get an intelligent picture of the essential conditions of the distributive problem.

The Sales Budget.—When to the information above listed there is added the ratio of previous output to the productive capacity of the factory, the sales manager is prepared to counsel with the budget committee, in the preparation of a sales budget for the ensuing year, and to parcel the quantities of this budget out to individual territories in the form of quotas

It may be thought wise to give the salesmen a voice in determining quotas. The Westinghouse Electric and Manufacturing Company, just prior to the beginning of its fiscal year, invites each of its 900 salesmen to make a survey of his area, talk with his customers, and recommend such a sales budget as he believes he can carry out. These estimates are reviewed by division and district managers, as well as at headquarters, after which with whatever revision may be necessary, they are established as the sales quotas of the new fiscal year.

"Quota setting is not only helpful in giving a goal to the sales force," says R. R. Deupree, General Sales Manager of the Procter and Gamble Company, "but it is a measuring stick for the Company to judge a salesman's work, and for the salesman to judge his own work; and the deeper significance of quota setting is the fact that the manager setting the quota must know conditions in the respective salesmen's territories. It is a whip on him

to know his job so that he can intelligently set a goal for his men."[1]

The Selling System.—Having established his sales quotas, the next step of the sales manager is to mobilize all the forces at his command to achieve them. He must secure the cooperation of the designing and manufacturing departments in producing a product suited to the market demands, of reliable quality, and in sufficient variety to give a workable trade assortment, so that a sufficient volume of sales can be made to keep selling expense down to reasonable percentages. The product may be such that it will be wise to individualize it out of its class, and make it so distinctive in its passage through the avenues of trade, and in consumer's hands, that good will can attach firmly to the brand, trade mark, and trade name.

The sales manager must organize and administer the selling campaign addressed to commercial and industrial corporations for whom the merchandise in question is equipment or supplies or raw materials; and he will enlist the aid of the company's engineering department to provide special service for such customers on the technical problems connected with installation of equipment.

In conjunction with the authorities of the manufacturing department, the sales manager will determine what service can be rendered in making repairs and what limits are to be set to the stocking of replacement parts for obsolete types of product. Upon this little-considered but expensive practice, the Chamber of Commerce of the United States has issued a bulletin, entitled, System in Scrapping the Obsolete.[2] "In heavy lines," says this bulletin, "such as engines, machine tools and similar equipment, the burden of carrying indefinitely patterns, jigs, and dies to reproduce duplicates and repair parts is very great, for it involves in some instances the providing of buildings for storage, fire protection and continuous clerical service, amounting to quite an item of overhead. In lighter lines the problem is simpler, but none the

[1] Strength and Weakness of Sales Managers, R. R. Deupree. American Management Association, N. Y., 1924.

[2] System in Scrapping the Obsolete, Washington, D. C., Jan. 26, 1923. Fabricated Production Department, Chamber of Commerce of the United States. Bulletin No. 21.

less important where it involves the carrying of slow-moving stocks or heavy inventories of duplicate or repair parts."

In certain lines of staple product a manufacturer can distribute through commission merchants, or through controlled but separately incorporated sales agencies, and in so doing reduce his selling functions to a minimum. The relations of the parties under such a system will be governed by the terms of a comprehensive agency contract of several years' duration. The adjustments required between the manufacturer and his distributors will be chiefly of an accounting and auditing nature; except that some sort of a campaign of publicity may be carried on to make the establishment known to the public, and to prevent the maker from becoming helpless in the hands of his distributors. If the marketing is done through controlled agencies, it will be found convenient to have them separately incorporated, not only because special charter powers, not possessed by the manufacturing corporation, may be needed, and because state license fees and taxes are thereby lessened, but also because the control of existing distributive businesses is more easily acquired if a capital interest can be retained by the former owners, while a valuable good will can sometimes be conserved by leaving undisturbed an existing firm name locally well known.

The relations with jobbers and retailers will need to be carefully worked out, so that, by means of price terms, the provisions of the contract of sale, and delivery schedules, dealers will receive such accommodations as their trade class and patronage warrant.

The relative importance of different classes of dealers to the sales manager will depend upon the avenues of distribution which are most suitable for the product he has to offer. If the products will be widely used by the public, and can be sold at a small price, he will shape his program with the small dealer and the jobber chiefly in mind. If, on the other hand, the product is one to be bought only after a preliminary process of price and quality comparison, plans for direct sales to department stores in shopping centers may occupy a large share of his attention.

The sales manager should have full supervision of the advertising which is addressed to dealers or consumers or both. One of the most important points in the distributive campaign is to secure coordination between the creation of demand and the sup-

plying of merchandise to satisfy it. It is a costly error to arouse consumers to ask for an article at retail stores only to find that the goods are not in stock; or to stock retailers with merchandise, and discover that there is no demand from consumers. In the planning room of a factory under scientific management, the routing function determines the materials which must be on hand at given dates, the workmen and work places then required, the dates for beginning manufacturing operations on different parts, and the progress of all chains of operations, so that there will eventually be as nearly as possible a simultaneous completion of the elements required for an assembly. A similar type of planning is required in sales supervision. Relying upon the factory schedules of output, it is necessary to so time the advertising, the salesman's approach, and the actual consignment of merchandise to dealers that, when the customer is ready to buy, the merchandise is ready to be sold.

The Manufacturer's Problems of Price

The manufacturer may adopt the policy of pricing his product, at the market of its class, and trust to energetic selling and the careful scrutiny of costs; or he may price below the market, trusting by volume of output to cut down the overhead charge per unit; or he may price above the market, relying upon superior design, unique packaging, exclusive features protected by patents, or individualization protected by brands and trade marks. The wide adoption of the last policy is a characteristic feature of recent American marketing.

The List-and-Discount Price System.—It is not uncommon for prices to be quoted by means of a nominal or list price, modified by various combinations of percentage discounts. The system, which is a sort of code with a key, possesses the convenience of permitting the list basis to be printed in large and expensive catalogs, while the actual prices can only be discovered by those who possess the discount sheets. The discount sheets take up little space, can be replaced at slight expense, and can be kept secret, while the catalog is freely shown. The list-and-discount system makes it easy to give a definite range of price discretion to salesmen for the entire line, or for any desired classes or articles in it, by simply designating the percentages

which they may add to the string of discounts. It, likewise, makes easy the giving of trade discounts or quantity discounts or cash discounts to different classes of buyers, by the same simple process.

The Cash Discount.—Discounts are quite generally given for prompt payment. The longer the interest-free credit term, the smaller is the pressure exerted on the merchant to turn his stock. The larger the cash discount, the heavier is the fine for slow pay. This system is, in reality, not a discount given for cash, but a premium charged to offset the hazard of slow-pay accounts.

Differential Prices.—The question arises in any merchandising campaign: To whom shall sales be made, and on what terms? If it is decided to sell to two classes of dealers, one of whom is the natural customer of the other, it is obvious that the primary dealer will be eliminated unless his price differential is protected. The system of differential prices is for the purpose of maintaining the jobber as a factor in distribution, while the manufacturer makes a direct address to retailers To apply differential prices successfully requires care in the compilation of trade lists, so that each prospective purchaser is quoted only those terms which are appropriate for his trade class. If it is decided to quote given prices to wholesalers, the question arises, What is a wholesaler? Is a department store which prints on its letter head "Wholesale and Retail," but develops no wholesale business outside of that which comes voluntarily as local accommodation, a wholesale house? Is a southern retailer, who in ante-bellum times got wholesale terms, entitled to those terms now? The usual definition of a wholesaler is a dealer who sells to dealers only, and who keeps at least five traveling salesmen on the road

If manufacturers are to be given wholesale terms, is a bicycle repair shop to be considered a manufacturer, when much larger sales are made at retail to the hardware store around the corner? If hotels are to be given wholesale terms, is a restaurant a hotel, and what shall be done with the boarding-house trade?

If too small a differential is allowed to the jobber, he will push rival lines. If too large a differential is given, he will make price concessions to the retail trade, and compete with the manufacturer for the business

Quantity Prices.—Another problem of price is whether, as between two customers of the same trade class, a lower price shall be quoted for a large order than for a small one. The professed reasons for the system of quantity prices, or concessions for large orders, are that it is a concession to the buyer of a part of the saving of business done in large lots, and that it is a premium to the dealer for concentrating on the line and moving large quantities Practically, the system exists as a concession to the club of large buying power, and as a means of loading up the small dealer when opportunity permits. The discount for quantity encourages overbuying It is, therefore, unsuited for the distribution of merchandise likely to deteriorate in the dealer's hands, such as tobacco, confectionery, and breakfast foods. The large dealer of his class usually desires to buy on the basis of quantity prices the small dealer desires to buy on the basis of differential prices, or prices fixed according to the trade class of the buyer Those manufacturers who make a point of catering to the small retailer and the local jober,—to so-called "regular" selling —make a point of avoiding quantity prices. Free goods, known as "free deals," thrown in with an order which exceeds a given size, are an indirect form of quantity price. A discount for quantity may be given on the basis of a single order, or of patronage for a period If it is for the orders of a period, the bid is for exclusive patronage, and the discount is a sort of agent's commission.

The Guarantee of Prices.—In businesses of a seasonal nature it is a great advantage to a manufacturer if he can induce his customers to place orders considerably in advance of the time when the goods will be wanted. To the buyer the placing of such advance orders means the assumption of the risk that prices will decline after the goods are bought, but before they have come into his possession, or before they are sold. To protect customers against these contingencies, manufacturers frequently guarantee their prices. This means that, if prices fall, there will be a price adjustment in favor of the dealer. The arguments in favor of this practice are· that it induces dealers to order for seasonal requirements much earlier than they otherwise would do, that with these orders the manufacturer can plan his production schedules ahead with greater assurance, that

he obtains the great advantage of a more even schedule of operations throughout the year, and that he can employ the idle warehousing facilities which are in the possession of dealers. It is urged that the guarantee prevents dealers from canceling orders on a declining market. And, finally, it is argued that the risk of price change can better be borne by the manufacturer than the jobber, because the manufacturer, through his purchasing department, is in touch with primary markets, and has a better means of ascertaining the future course of prices than has the jobber.

Against the guarantee of prices by manufacturers it can be said that it contravenes the principle of the division of labor. Manufacturers should compete with each other, chiefly, on the basis of manufacturing processes and manufacturing costs, which are their special province. Merchandising risks should be carried by merchants. It violates good finance, for jobbers are better able to undertake external financing than manufacturers, since their assets are largely liquid, while the manufacturer's assets are largely fixed: furthermore, jobbers take full advantage of price advances, and the profits thus secured are the logical fund to cover their losses when prices fall. It also contradicts a principle of price for, while advances in price usually come from the supply end of the commercial chain, declines in price usually proceed from the demand end, and should be diagnosed by distributors before they are felt by manufacturers.

The system of guaranteed prices encourages over-buying and speculative buying because, if prices advance, the buyer profits while, if they decline, the seller indemnifies. Consequently, it tends to keep needlessly large quantities of merchandise in the avenues of trade. It tends, also toward artificial prices, for manufacturers who are under guarantees will exert all possible influence to prevent prices from falling. The guarantee is an indefinite contingent liability for the manufacturer. It makes a troublesome item for proprietorship and cost accounting. It is a poor method of securing a degree of regularization of manufacturing operations.

Some manufacturers guarantee on prices of merchandise unsold in the hands of merchants, while others guarantee only on sold but undelivered merchandise. Some guarantee against a decline of trade prices, while others guarantee only against lower

prices quoted by themselves. Undoubtedly the more conservative position is the better one. The practice of Deere and Company of Moline, Ill, is that the guarantee shall be limited to the following conditions: to a definite date immediately preceding the farmer's demand, to declines in the manufacturer's own price only, and to goods which are in the dealer's hands unsold at the specified date.

The preponderance of opinion among manufacturers appears to be against the practice. Many associations of manufacturers have roundly denounced it as a violation of the principles of sound business. It is excess of zeal in competition among manufacturers which is largely responsible for its continuance.

The Control of the Price of Resale.—In recent years there has been a great increase in the amount of merchandise on the market which is individualized, and which can be identified by means of characteristic appearance, or by trade marks or trade names Some of these articles are widely advertised, so that the utility and the customary prices are known to many customers. When such articles are offered at cut prices, they make a definite impression of cheapness They have, therefore, to some extent been used as leaders, or as sample offerings, from which the intention is that general price levels shall be inferred. When this use of a leader breaks down the market price of an article, so that normal profits cannot be obtained on it, such retailers as the local convenience stores, which cannot secure the advertising value, cease to handle it, or if they handle it, as an accommodation to customers, they subordinate it to profit-producing merchandise This loss of trade arouses the manufacturer.

The plan originally resorted to, in the effort to eliminate price cutting, was a series of contracts entered into between manufacturers and dealers, stipulating the prices at which dealers should sell, and providing various penalties for violations. These plans are now illegal under decisions of the United States Supreme Court, interpreting the Sherman Anti-Trust Act of 1890, the Federal Trade Commission Act of 1914, and the Clayton Act of 1914. As a consequence, a vigorous campaign was carried on, for some time, in favor of special legislation granting to manufacturers the power to control the prices dealers might charge for their products.

In behalf of such proposed legislation, it has been urged that

when a manufacturer individualizes his product, and by various means identifies it with himself; he publicly commits himself to give good value, and he tacitly agrees that the quality shall be commensurate with the price asked. The consumer who buys such an article knows what he is getting and, by observing the characteristic appearance and the trade mark, can protect himself against substitution. The manufacturer of such an article deserves, therefore, to be protected—or allowed to protect himself—against such treatment of it at the hands of certain dealers as will make it unacceptable to other dealers, or which will destroy the value sense of the general public with respect to it. It is held that price cutting of identifiable articles, for use as leaders, necessitates an inflation of the prices at which unidentifiable merchandise will be sold to consumers. When the incentive of many merchants to carry identified merchandise has been removed by the action of a few merchants, the consumer is unable to obtain the goods he desires. To control resale prices is a move to prevent the large dealers from driving the small retailers out of business; and is a protection to the small neighborhood-convenience store.

In opposition to the project for the control of prices of resale it may be pointed out that the value of the individualized, trade-marked, and widely-advertised article is not at issue, but rather the granting of a new and unusual power of control over commerce to the manufacturers of such goods. As the Boston Chamber of Commerce points out: "The cutting of prices of standard articles so as to invite trade on other articles is infrequent and usually carries with it its own financial punishment." "No instances of the small dealer or the large manufacturer having been driven out of business, by reason of the existing law, has been brought to the attention of the committee." [1]

In opposition to resale price control, the Boston Chamber of Commerce points out that "such legislation would not allow for the wide differences in the costs of retail store operation—differences which are frequently due to differences in services rendered. If a retailer can operate more cheaply by dispensing with certain services, such as delivery, for example, and his customers are also willing that these services be dispensed with, then it appears

[1] Arguments in Referendum on Maintenance of Resale Prices, Boston, May 8, 1916. The Boston Chamber of Commerce.

to be just that the retailer should be permitted to charge lower prices on all goods sold by him." [1]

The retailer should be as free as other business men to run his own business. There is a special point in maintaining this freedom in the field of mercantile distribution which Professor F. W. Taussig has thus elucidated: "The spread between the price received by the prime producer and that paid by the consumer ing is astonishingly large. Various experiments are on trial for lessening it. . . . The department store grows apace. The chain store plan has its successes. . . . What will finally come of all this, it would be rash to predict. The jobber may remain: the country storekeeper is not likely to disappear; retailing on a modest scale has shown a tenacious vitality in face of the attacks of the department store. There is no possibility of saying in advance just what the situation will be a quarter century or half century from now. But the only promising way of getting a more effective distributing process is to let any and every experiment be tried by any one who thinks he can do the thing more cheaply. And this would seem to be a decisive reason against encouraging the fixed-price system. It stands in the way of the experimenter. As regards the spread between producer and consumer, it looks to the maintenance of the *status quo*." [2]

As the law now stands, a manufacturer can, as a strictly individual transaction, refuse to sell his merchandise to a price cutter. He can, of course, enter into the relations of principal and agent with distributors, and in such relation exercise the usual powers of control of a principal over his agents; but he cannot use this form of relationship as a cloak for effecting a contract in restraint of trade. The courts give attention to the essential purpose and the effect of agreements, rather than to the mere outward garb. No agreements with others to report price cutters, or to boycott or otherwise punish price cutters, can be legally carried out. Nor has a manufacturer the power to encumber a chattel with price restrictions, during its progress through the avenues of trade, after he has received his price for it, by reason

[1] Arguments in Referendum on Maintenance of Resale Prices, Boston, May 8, 1916 The Boston Chamber of Commerce

[2] Price Maintenance, F W Taussig American Economic Review, March, 1916, Supplement, Vol. 6, No. 1, p. 181.

of any fancied privileges growing out of his ownership of patents, copyrights, or trade marks.

Price Policies and Restraint of Trade.—It is essential that a manufacturer, in interstate trade, should confine his practices, with reference to prices, strictly within the law, as laid down in the Interstate Commerce Act of 1887, the Sherman Anti-Trust Act of 1890, the Federal Trade Commission Act of 1914, and the Clayton Act of 1914, and as interpreted by the orders of the Federal Trade Commission, and the decisions of the United States District Courts and the United States Supreme Court.

By various decisions of the courts, manufacturers who are competitors have been forbidden to agree or conspire to adopt uniform basic list prices, freight basing points, frieght equalization plans, trade differentials, plans for maintaining resale prices, cash discounts, terms of sale, uniform package differentials, credit terms, trade lists, trade marks, guarantee of prices, or plans for excluding price cutters. Competitors cannot agree to pool output, maintain a joint selling agency, regulate the amount of stocks to be carried, curtail output, or divide territory. They cannot agree to adopt any uniform element which is to be introduced into price, or to adopt any uniform method of calculating prices In short, every contract, combination, or conspiracy which effects an undue or unreasonable restraint of trade or commerce is illegal.

Problems

Manufacturing as a Process of Buying and Selling.—It has been said that, " Our whole industrial society is in a sense a market society. A loan at a bank, the hiring of a worker at a factory, the ordering of a meal at a restaurant, the issuance of stocks and bonds of a corporation, the lease or purchase of land, the payment of tuition at a university—indeed, the major part of the business happenings of our daily life—are either market transactions or closely allied thereto "

Consider to what degree the activities of a manufacturing corporation can be resolved into a series of buying and selling transactions, and compile a list of such transactions.

Organization and Functions of a Sales Department.—Secure a copy of the questionnaire developed by the Committee on Sales Questionnaire of the Taylor Society, and published in the Bulletin of the Taylor Society for December, 1921, Vol 6, pp 244–248 With this as a basis, interview a number of sales managers in your locality as to the organiza-

tion and functions of the sales departments with which they are connected. Digest the replies, draw conclusions, and prepare a report.

Product Analysis as a Basis of Selling Systems.—Select some article which is in general use in homes, preferably, perhaps, a mechanism, such as a kitchen range, and make a house-to-house canvass, until about twenty-five successful interviews have been made with the persons actually using the article. Do not confine the inquiry to any one make or brand of article. The object of the inquiry is to discover the defects of the product, which were overlooked by the manufacturers, but which have come to the attention of users. The interviews should be prepared for in advance by a careful preliminary study of the article. It may prove of advantage to prepare lists of questions which will prevent matters being overlooked. But care should be taken not to destroy spontaneity of response.

It may be well for the interviewer to carry with him a letter of identification and explanation from the instructor in charge of the course. The study can be handled by correspondence, but probably with inferior results. Record the information received immediately after each interview fully. After the data have been secured, examine and classify them, and draw up a report with conclusions.

The subject may be followed further, by submitting copies of the report to manufacturers of the product studied, and obtaining explanations from them.

The Market for a Product.—It has been said that, "A manufacturer cannot safely assume that his product will appeal alike to all classes of consumers. Differences in living conditions, in occupations, in habits and customs, and many other factors, as well as general business conditions, determine the class or classes of consumers from whom he may expect the demand for his product to arise. He needs to know where the potential consumers are located and what volume of sales may be counted upon. The more definitely he can determine the potential market, the more readily can he solve many of his other marketing problems."

From what sources can the manufacturer secure information which will throw light upon the location of "potential consumers"? Make an independent survey, and consult the literature of selling, especially, M. T. Copeland, Business Statistics, Cambridge, 1917. Harvard Univ. Press, and Wm. A. Berridge and Others, Purchasing Power of the Consumer, Chicago, 1925. Shaw. Also, Domestic Market Possibilities for Electrical Merchandising Lines, Trade Promotion Series No. 9, Domestic Commerce Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., 1925.

Manufacturer's Versus Jobber's Brands.—The Federal Trade Commission has summarized the arguments of a discussion, long carried on in trade circles, as follows "Labels constitute an important problem because of their effect on price. Packers, as a whole, prefer to pack under their own labels and insist that the wholesale grocers are enabled to obtain higher prices through the use of their private brands. The wholesale grocers, on the other hand, argue that their brands bring about a standardization and an improvement in grade for which nothing is added to the price The packers insist that the consumer wants to know by whom and where his goods were packed The wholesale grocer thinks that the consumer wants to be assured of the quality and believes that private (jobbers) brands furnish this assurance The wholesale grocer argues, first, that he handles a great number of things and is able thereby to develop amongst consumers a knowlegde as to his brands. Second, the wholesale grocer has a large area from which to draw, so that if one canner's pack is not of such a good quality it will be sold as an inferior grade, and another canner's pack will be purchased for the higher grade."

Which of these two—the jobber or the manufacturer—is more likely to supply a satisfactory article to the consumer under his brand? Secure literature from national associations of specialty manufacturers and from jobbers' associations For addresses see, Commercial and Industrial Organizations in the United States Bulletin No 99. Miscellaneous Series, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington Superintendent of Documents, 20 cents. With these replies complete the construction of the opposing arguments.

Submit these to local grocers and hardware dealers to ascertain which of the two classes of goods is purchased by them the more freely, which sells the more easily, and which leads to the less number of complaints.

When Title Passes.—The following question was asked in a trade journal "In a case where we purchased goods, sight draft against bill of lading, the goods being shipped consigned to the shipper, notify ourselves, and the bill of lading being forwarded attached to a draft with instructions to the bank to deliver the bill of lading to us on payment of the draft, who is the owner of the goods before the draft is paid "?

Law of Passage of Title.—Compile from legal references a brief statement of the law of sales of personal property with reference to the time when title to the merchandise passes from the seller to the buyer, and explain some of the more important distinctions or determinations of the law, from the point of view of the sales manager

Figuring the Discount.—"We have a contract covering a commodity sold to us f o b shipping point, freight allowed to our city The terms

of payment are 30 days net, 1 per cent 10 days. The concern seems to feel that we are only entitled to 1 per cent of the net amount of the invoice, i e., the difference which is obtained after deducting freight charges, which they allow us in accordance with the terms of the contract, from the gross amount of the invoice. We feel that we are justified in making the deduction from the gross amount of the invoice To cite an instance, the last invoice which was received from these people amounted to \$1026 10 less freight \$150 01, difference \$876 09. We feel that we are entitled to deduction of \$10 26 for the 1 per cent discount, while they allow us only \$8.76 This question has also been raised in connection with transactions between ourselves and other concerns" Which side is right in this controversy?

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CHAPTER XXV

ADVERTISING

Advertising is a sort of machine-made, mass-production method of selling, which supplements the voice and personality of the individual salesman, much as in manufacturing the machine supplements the hand of the craftsman. The cost of bringing an appeal to an individual by advertising has been estimated at from $\frac{1}{100}$ to $\frac{1}{300}$ of the amount required to establish contact by personal visits Advertising can, therefore, be spread broadcast as a drag-net, while salesmanship must be reserved for specially remunerative territory.

The moral effect of advertising upon the one who issues it is that of being definitely committed, of having taken a stand of a public nature, of having invited the judgment of many, and of having conceived and written of ideals—ideals of healthfulness, cleanliness, safety, and economy. Upon the general public there can be no doubt but that the constant sight of announcements of high qualities in goods, and the constant reading of protestations of social service as the motive of business action, exerts an influence in the direction of elevating the standards of taste and of conduct It is to be feared, however, that the constant drawing of the public thought to the consideration of goods, and to the carnal satisfactions involved in the use of goods, exercises a materializing influence, and tends to propagate the error that happiness lies chiefly in the possession of things

It requires a higher degree of intelligence to sell by description than it does by sample· and it necessitates higher ethical standards In order to have something convincing to say of an article, it is necessary that the article possess qualities that can be talked about In most advertising the cost of getting the first sale made is greater than the profit derived from the sale If an article is not what it is advertised to be, this initial loss will not

be recouped by profit from repeat orders. What the advertiser aims at is to establish in the consumer the habit of buying his product If the product has not distinct superiority of quality, it will not be bought frequently enough to establish such a habit The trade mark on an article serves as readily to assist a dissatisfied customer to avoid it as it serves the satisfied customer in selecting it. All of these matters enforce the necessity of honesty for the achievement of any lasting success through advertising.

Waste in Advertising.—The amount spent in advertising in the United States, annually, has been variously estimated at between 1000 and 1500 million dollars. There is no secret made, by advertising experts, of the enormous waste involved in this department of business effort. A well-known text on advertising explains as follows: " Consider the case of a publication with 100,000 readers producing 3000 replies and 300 sales. Such a result is a remarkable one viewed from the general average of practice, and yet it represents only three-tenths per cent efficiency of orders." [1]

The experience of an advertiser with a selected list of names which was carefully observed for changes, likely to affect the probability of buying, is illuminating. In this list of 1000 names in three years:

410 changed addresses from one to four times,
261 moved to parts unknown,
124 had already purchased the product,
83 had bought a competing article,
7 had died, and
1 had gone to jail.

A total of 886 out of 1000, or practically 90 per cent, had become worthless as prospects For every dollar spent on the above list ninety cents was thrown away [2]

In spite of a wastefulness like that of insensate nature, which showers down ten thousand acorns to secure a single oak sprout,

[1] Advertising, Tipper, Hollingworth, Hotchkiss and Parsons, N. Y, 1915 Ronald, pp 10–11

[2] How to Get and How to Keep Business, W. H Patterson. Proc Eighth Annual Convention American Industrial Lenders' Association. Harrisburg, Pa, 1922, pp 56–57.

or which spawns a million eggs to bring into being a single herring, advertising has established itself as part of the machinery of competition which is indispensable, for the time being, in many branches of industry. The individual advertiser may realize the waste, but he prefers it to economic extinction. He is like a poor swimmer who has had little training and loses three-fourths of the energy he puts forth, but who nevertheless prefers to continue to thrash the water rather than be drowned

Functions of the Advertising Manager.—The advertising department should be a section of the selling department, the advertising manager working under the general supervision of the sales manager. Such a relationship recognizes the fact that advertising is one among a number of agencies of selling, and that it can only reach its highest efficiency when adjusted to work harmoniously with other agencies, in a general plan.

The functions of an advertising manager may be listed as follows

1 Assist in the choice of an advertising agency

2 Assist in the choice of a trade mark and a package, and in the determination of all the mercantile characteristics of the product

3 Take part in preliminary studies necessary to secure the information on which the advertising campaign will be based

4 Plan the distribution of such goods as are to be used for samples or for demonstration purposes

5 Recommend the amount of the advertising appropriation.

6 Assist in the choice of advertising mediums

7 Determine the size, position, and frequency of insertions

8 Assist in the construction of the advertising literature

9 Devise and operate a system, as a part of the process of auditing advertising accounts, for determining whether or not the advertising charged was actually published, the billboard showings made, etc

10 Utilize these and other records to calculate unit costs per medium, and to deduce all other results of value from the experience gained.

The Advertising Campaign.—Advertising aims to commit the producer, educate the consumer, supplement the salesman, convert the dealer, and eliminate the competitor. Chiefly, it is a link between producer and consumer, as such it can only be efficient when based upon a knowledge of products and of human

needs. The expense of modern advertising campaigns, the necessity of continuing effort when a campaign is once begun if the buds of inclination started by each appeal are to be ripened into actual demand by succeeding appeals, the fixity of design, trade mark, warranties, prices, and distributive agencies essential if the advertising is to be specific, and is to build up a system of distribution,—all these are circumstances which emphasize the need of making a careful preliminary preparation for a campaign. One of the best known advertising agencies has said, " Most of the failures in advertising come from guessing at things which could just as well be proved. We find out if an article can carry a precinct before attempting to carry the country.

" A house-to-house canvass develops selling arguments quicker than anything else. One has no idea how many theories are upset by facts until he meets his prospective trade."

A ready-made advertising campaign cannot be bought; nor can a campaign used successfully by one corporation be copied by another with any guarantee of like results. Each case requires to be worked out upon the basis of the product, the nature of the act of consumption, the buying motives, the financial importance of the purchase to the consumer, the frequency of purchases, the classes of dealers from whom purchases will be made, the rapidity of style change, the difficulty of keeping merchandise in good physical condition, the seasonal factor, the class of people who will be interested, the competition, etc.

Advertising and the Laws of Attention.—The steps through which the advertiser attempts to lead the prospective purchaser are, a state of attention, an awakened interest, a memory impressed, and a determination formed to buy. The prehistoric struggle of the human race for survival has led to the production of a type of beings who give prompt attention to large objects, to objects the nature of which is not understood, to moving objects and those possessing the appearance of life, to objects of bright color, to sudden appearances and disappearances, to the first and last members of a series of similar objects and, in general, to all those things which contain a threat of injury or a promise of well being. There is in modern civilized life an intense competition of objects and ideas to become the subjects of attention; but the field of consciousness is very narrow, concerning itself with the things

which are most comprehensible to us, and which seem to us to be of most value. Of those things which are intentionally noted, and which can be recognized at a later time, but a small proportion acquire a tendency to be voluntarily recalled.

Advertising and Interest.—Attention once secured, the advertiser's next object is to awaken interest. The process is the simple but by no means easy one of holding the attention. That which retains attention must possess parts of sufficient complexity to invite renewed inspection, and must reward study by revealing new points of significance. A rational progression must be opened to the thought, and one which facilitates advance toward the goal-idea with which the mind of the beholder presently becomes possessed. Things interest us which are concrete and objective, and which mirror for us the world of the senses, rather than that of general concepts. Our interest is aroused when things reveal associations among themselves, and more so when they knit themselves onto our previous stock of knowledge, and reveal a new significance in old facts. Especially do things interest us which concern ourselves.

People are moved by pertinent truth, associated with pertinent emotional values. Indefiniteness of conception, or weakness in the association of the parts of a composite impression are fatal. Clearness, mastery, and veracity are characteristics which possess never-failing power to arrest the attention. To arouse interest is not primarily a literary process of dressing ideas in appropriate language; it is chiefly a matter of choosing the right ideas, and of bringing them out in the right order. Few things are more fatal to interest than the suspicion of exaggeration. Restraint refreshes interest, for it is a sign of strength held in reserve, and strength always attracts attention, for it contains the promise of future interesting revelations of itself.

Advertising and Memory.—When attention and interest are assured, memory will be impressed in the degree that the matter put before the person agrees with his type of mental imagery. Memory is, in part, a function of the sharpness and vividness of the original impression, a matter which depends not only upon the material presented, but upon the occasion, the preparedness of the subject's mind, and the length of the observation. It depends also upon the frequency with which the impression is renewed. This

is not the same as saying that it depends upon the frequency with which an advertisement is presented to the consumer. Attention soon passes over that which does not unfold new significance. The frequency which counts is that of the intentional apprehension; not of the approach, nor even of mere passive recognition. There is in advertising much stupid repetition which overlooks this point, and proceeds on the assumption that if a trade mark can be shown often enough to a reader, or an electric sign can be flashed frequently enough before the passer-by on the street, his trade must come as a mere matter of physics.

The fallacy of this is illustrated by the psychologist Meumann, who said, " I made systematic inquiries of a number of students as to whether they could describe the wall-paper of the rooms in which they studied; whether they could describe the dishes which they used every day at table; how many steps they ascended daily in the university stairways; whether they could name the buildings which they passed every day; whether they could describe or sketch the most striking church spires of the city; whether they could sketch the outline of mountain-peaks which they have seen often and attentively; whether the four upon their watch dials is indicated by four I's or by IV, and the like. To all questions of this sort one obtains exceedingly uncertain or even erroneous answers Remembrances of everyday experiences are frequently so uncertain that the student becomes vexed and wishes to discontinue the experiment.

" These and similar observations prove that memory fails to retain many impressions that come to us countless times during our lives. They prove further that it is not the mere repetition of impressions as such which constitutes imprinting, and makes it possible for us to reproduce, especially to reproduce freely; on the contrary we find that, as a rule, we remember only what we have apprehended attentively and with the intention of remembering it." [1]

Memory is also a function of the number and strength of the associations which are established between an idea and other ideas in the mind; by virtue of which when any of the related concepts emerge into consciousness, the particular idea is drawn up also.

[1] The Psychology of Learning, E. Neumann, N. Y, 1913 Trans by J W Baird Appleton, pp 315–316

If an advertisement leads to some form of motor response, such as writing for a catalog or a sample, the data of the advertisement will be set in a complex of impressions easily remembered

We remember best those things which are easily classified and for which we can find an adequate word-symbol to serve as a name In proceeding from one idea to another, in the act of recalling, we advance more easily from particular instances to general categories than in the reverse direction.

Disagreeable associations are to be avoided The disparagement of rival products is inefficient advertising, inasmuch as it causes defects to be recalled along with the advertised article, and leads to the conviction in the reader's mind that the class of articles in question is unreliable. As a rule this law of association is well observed None of the canned-beef concerns have exploited in their advertisements the fact that they supplied the United States Government during the Spanish War!

The Choice of Advertising Mediums.—Among the various mediums by which the advertiser can reach the consuming public, or the dealer, may be mentioned form letters, booklets, magazines, trade papers, house organs, catalogs, newspapers, and billboards, not to speak of electric signs, window displays, and samples These means are capable of classification in various ways as national or local, of general appeal or class appeal, paid for by the consumer or thrust upon him. No two of them are alike They cannot be used indiscriminately. Each should be studied, and its capacity to do a special kind of work measured as definitely as possible.

The general sequence of events in an advertising campaign, as concerns mediums, is that, first, the general broadcasting of the message takes place, with the use of mediums which reach many persons at low cost. Second, as individuals respond by inquiries or purchase orders, a follow-up of more intensive character is inaugurated, with the use of local or individual mediums of more expensive character A general advertising campaign will produce different results upon different individuals. Some will be moved to order directly or make inquiry of local dealers. A larger number will be disposed to buy but, because of the lack of immediate need or of available funds, will postpone any response which registers definitely with the advertiser. A still larger class will be

sufficiently impressed so that, if their attention is again attracted to the proposition, the subsequent publicity will be like seed sown in prepared ground, and will bring them into the second or the first classes. The beneficial results of advertising include quite as much the impressions made upon the second and third classes of persons as they do the orders received from the first class. It is the purpose of the follow-up program of definitely directed agencies to intensify these impressions, and by careful nurture, ripen successive crops of demand from them. The mechanics of the follow-up are principally connected with its recurrence. The reminder must be frequent enough to produce a cumulative effect, without being so frequent as to produce impatience.

Form letters, because of the small expense connected with them, may be used as a means of exploring a field and of securing information for the guidance of the major campaign. One successful concern uses form letters in batches of 500 to ascertain what classes of persons are its natural patrons. The results of these appeals are tabulated, reduced to percentages, and compared. The same firm sends out letters at different seasons of the year. Again, batches of letters of different composition, and embodying different arguments, have been sent out, as a result of which it has been possible to select the stronger forms of appeal and to eliminate the weaker ones.

Magazine advertising aims to give wide publicity to a firm's name and trade mark; and to create prestige for a product by the impression of extensive and permanent connections and respectable company. The ability of the magazine to arouse desire for merchandise has been much improved in recent years, through better illustrations made possible by improved paper surface, better printing presses, the use of half-tone cuts of drawings and photographs, and the introduction of color printing. The picture is a powerful aid for presenting that class of articles for which desire springs up on sight. A considerable degree of leisure, wealth, and refinement are assumed in the reader.

Since the appeal of the magazines is so widely scattered geographically, it is difficult to secure adequate distribution of goods in the hands of dealers. The advertisements, therefore, often contain arrangements for taking care of mail orders. The more usual plan is to bid for inquiries, stimulating these by the offer

of samples or free booklets. The object of inviting inquiries is to secure letters which can be laid before dealers in the places of origin, as proof of the existence of a demand. When an adequate distribution of merchandise is finally made to dealers, consumers are referred to the local stores, and direct sales, or even inquiries, are no longer encouraged.

Trade papers are dominated by a professional or vocational interest. The audience is usually small but select, technically well informed, in earnest, influential, and marked by certain professional characteristics The nature of the appeal to such an audience must be informational on the highest plane of accuracy as to facts. The trade paper assumes an important place in the distribution of those commodities which are bought on the advice of a dealer or professional expert. It is important for articles of intricate construction, and for things which must be installed by persons of experience

A booklet is a printed letter elaborated as much as possible, without causing it to be separated from first-class mail It is a catalog, sufficiently compressed to ensure its delivery with first-class mail It provides more detail than a letter, but retains the informal and personal tone. It offers less information than a catalog; but like the catalog uses illustrations, and in some cases groups the subject-matter according to articles offered. It trusts much to artistic covers, and to the inclusion of disinterested information, to save it from the waste basket In its appeal to art it resembles the calendar, which is a little poster; in its incorporation of general information it treads in the steps of the ancient almanac.

Newspaper advertising belongs, in general, to dealers A manufacturer may use it locally, however, to precipitate the uncrystallized good-will created by general advertising, in the form of a demand with the local dealer. After the general advertising campaign in the magazines has made an impression upon many minds, the local newspaper may be used to push almost-persuaded persons over the line, and indicate to them just where, in their locality, they can purchase the goods Local advertising is often the price the manufacturer must pay to secure the services of a desirable local dealer to act as his distributor.

The dominant idea of the newspaper is news A paper a day

old is dead. The reading is hurried. Advertisements must be striking, informal, and timely: a brief appeal for prompt action. To a certain extent we may classify the morning papers as those read by the professional classes and business executives, and the evening papers as those read by the masses. The morning papers are read hurriedly; the evening papers more at leisure. The medium suffers from the heterogeneous character of its audience and, frequently, from the lack of censorship of the advertising columns

A house organ is a private magazine. Following the model of a magazine, it may contain a wide range of matter, such as news of the factory departments, helps for dealers, trade news, ginger talks, and humorous items. It thus provides a broad common ground upon which advertiser, dealer, and consumer may stand and get acquainted. The house organ is beyond the means of small concerns. It is exacting as to quality, and as to the regularity of issue. Its chief weakness is that it is laid upon a busy man's desk during his working hours.

A catalog aims to supply all information needed to place an order. Because of its expense it is usually to be distributed only to those who manifest a serious interest, either by making an inquiry for it, or by sending for a booklet, by purchasing an article, or otherwise.

The trade mark has something of its original significance, among the foreign born and the negro populations, as a sign which can be identified by those who cannot read. If a trade mark cannot be readily described in words, however, it loses half its value. As a convenient symbol, the trade mark helps any class of customers to make quick selection. There is a valuable quality of exclusiveness which is protected by law.

The billboard is the final result of the evolution of the poster. Though endeavoring to trace its lineage back to the ancient tavern sign of coaching days, it was in reality born of the needs of the American circus. It is a "tax payer," able to pay a portion of the carrying charge of unimproved real estate. A poster is, at most, a picture in colors, with an epigram; reduced to its lowest terms it is a name or a symbol printed large. Seen but for a moment, it must convey its message in a flash. Its audience is the average population of the street: the appeal is indiscriminate It pos-

sesses many defects: among others that it demands attention from people who are occupied with making their way along the street and in avoiding passengers and vehicles. No two positions have the same value It cannot be keyed It is difficult to check up showings. The paper is easily defaced, and is expensive to replace Furthermore, there is an increasing section of the public which regards the billboard as the chief defacement of American cities George Fitch has said, "The billboard not only reaches out and attracts the passer-by's attention, but it lams him with a club if he happens to be a man of good taste."

The commercial package is a protection in shipping, a quantity ready measured and wrapped, a display item for the dealer's shelves, and a container for the consumer's pantry or storeroom. Its chief significance, however, is that it serves to individualize the merchandise it contains, and to carry the trade mark and trade name, as well as directions for use, and the advertisement of other products The size of the package is adjusted to make the act of repurchase sufficiently frequent so that merchandise will be in good physical condition, and so that the buying habit will be exercised and kept alive

Advertising by Trade Associations.—Competition not only exists between firms in a given line of industry, but between different trades which manufacture entirely different products Thus, there is a lively competition between the manufacturers of white pine and southern pine and cypress and brick and tile and cement in the building industry There is competition between china and glass, between prunes and oranges, between the attractions of an automobile trip to Northern Michigan and a railway trip to Yellowstone Park. In these contests of trades and of groups of industries, for the time and money of the consumer, considerable use has been made of trade associations for the management of trade-promoting campaigns "Say it with flowers," contests with "Eat more ice cream": "Save the surface and you save all," rivals "Use plate glass." The trade association forms a means by which producers, who are individually too small to conduct a national advertising campaign, can combine to bring themselves before the general public Instances of this are the work of the California Fruit Growers Association, the Florida Citrus Exchange, the Sun-Maid Raisin

Growers Association and the Dairymen's League Cooperative Association.

Problems

Buying Motives: General Consumption Goods.—Cut from the general magazines 100 representative advertisements, covering a variety of articles used in general consumption Make a study of these advertisements, listing the different buying motives (or the utilities of the merchandise) appealed to, and the number of times each is used. Classify the results, and draw conclusions.

After this work is finished, but not before, examine the classification of buying motives presented by Prof. M T. Copeland in his Principles of Merchandising, Chicago, 1925. Shaw, Ch. VI, Consumer's Buying Motives, pp 155–189. Compare this classification with your own, and discuss any differences which exist between the two.

Buying Motives: Industrial Goods.—This project is similar to the one above, but pertains to industrial goods Cut from the trade and technical magazines 100 advertisements addressed to manufacturers, and presenting a variety of such equipments, supplies, etc, as are used by manufacturers in the process of carrying on business Make a study of these advertisements, listing the different buying motives (or the utilities of the merchandise) appealed to, and the number of times each is used Classify the results, and draw conclusions

After this work is finished, but not before, examine the classification of buying motives presented by Prof. M. T. Copeland in his Principles of Merchandising, Chicago, 1925. Shaw. Ch. VII, Buying Motives for Industrial Goods, pp 190–215.

Influence of Advertising Campaigns on Competitors.—Do the advertising and selling campaigns of the major advertisers, whose publicity presents to the public some improved consumption good or some perfected mechanism, but which also incidentally emphasizes the general class of goods to which the one advertised belongs, or which emphasizes the importance of doing what the improved article will aid in doing, help or hurt the manufacturers of other articles of the same general class or other mechanisms, not so improved, for doing the same or similar work?

Select some lines of merchandise which, in your opinion, may be in the latter class, and write to the manufacturers for their experience

Reference—Paul T. Cherington Advertising as a Business Force, N. Y, 1913. Doubleday, pp 60–61.

Street Car Advertising.—For what kinds of products, and what merchandising situations, are street car cards best fitted? Make a tabu-

lation of the things advertised, and the classes of advertisers (manufacturers, chain stores, department stores, single line stores, neighborhood stores, service industries, public utilities, etc) in the advertising of your locality If you were a department store merchant, and were contemplating the use of cards in the local street cars, how would you check up the results produced, and so obtain an estimate of the value of the medium?

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CHAPTER XXVI

THE TRAFFIC DEPARTMENT

The business of properly relating the shipping activities of manufacturing corporations of size to the American railway system is an undertaking which demands executives of first class talent. Upon the traffic manager rests the responsibility to ascertain the railway rates applying to his company's products within the field of his company's in-and-out-bound shipments He must also determine the best routings, to secure speed, diminish hazard of breakage, and give the most convenient terminals. He shall analyze his company's products from the point of view of traffic economy, determine the grouping of articles into packages and shipments so that the best rates may be secured, supervise packing and marking to avoid loss, damage, and misshipment, and procure from the railways the promulgation of through rates needed, where none exist As the facts may warrant, he will petition for changes of class or of rates or of carload minimum weights.

The traffic manager will intelligently utilize the car services offered by the railways. On occasion, he will employ such other services as reconsignment and stoppage in transit He will follow up delayed shipments, and will secure the adjustment of claims for overcharge, delay, or loss and damage He will handle the affairs of his office in a business-like manner, so that there will be complete records, and so that all documents given to carriers shall be clear, legible, and complete. He will enforce prompt handling of his company's freight at terminals and, as may be possible, will direct his company's patronage in such a way as to lessen congestions, to avoid unnecessary handling, to employ railway rolling stock economically, and to regularize freight movement throughout the year.

The traffic department will bear close relations to the sales

department, in as much as it may be said that the delivery of merchandise to a carrier is an act more closely connected with selling than with manufacturing. Goods are shipped, where, when, and in the quantities ordered by the selling department. The cost of delivery is often absorbed as a part of the selling price, and so becomes an item the limits of which must be controlled by the same factors which control the general process of price setting. The selling department finds its field determined, in part, by the speed and cost of shipment. Errors in shipment, or delays, bring complaints to the sales department for adjustment, and may even require the sending out of duplicate merchandise.

The traffic department should furnish to all buying officers on request, information as to the length of time required to secure supplies from designated places, and as to the relative freight rates from rival supplying points. It will ship merchandise on order bills of lading, when instructed to do so by the credit department; and on the motion of the credit man it will exercise the right of stoppage *in transitu*.

Freight Rates.—It is the chief business of a traffic department to compile information as to the rates of freight applying to the merchandise made or handled by the house, within the territory which constitutes the field of operations. The chief factors which enter into the determination of freight rates are (1) the value of the service to the shipper (a sum which may be measured roughly by the difference between the value of the merchandise at the initial point and the value of similar merchandise at the point of destination); (2) the cost of performing the service, including not only an indefinite share of the joint costs of carrying on the freight service of the carrier as a whole, but any special costs such as those for special cars, special switching, prolonged use of terminal space, the labor of tending, as in taking care of cattle, and the risk of loss, such as the liability of fruit spoiling, etc.; (3) competition with other carriers, (4) protection of vested interests; and (5) compliance with the requirements of law. The law prohibits a carrier from charging a higher rate "for a shorter than for a longer distance over the same line or route in the same direction, the shorter being included within the longer distance," unless with the consent

of the Interstate Commerce Commission. This consent is to be given only when such a rate is "reasonably compensatory for the service rendered." The law also provides for a large degree of control over rates by the Interstate Commerce Commission, with reference to their amount, the manner of publication, and equality of treatment of shippers.

Rate Classification.—The first step taken by the railways in determining freight rates is to group the many thousands of articles which may offer themselves for transportation into a few classes, so that a correspondingly small number of class rates will provide a determination of the charge to be made in any individual case. The railroads of each great region are united in the support of classification committees. There are three general classifications: Official, Southern, and Western. These are united in promulgating the Consolidated Freight Classification which covers the United States and Canada.

The Official classification covers the territory bounded by Canada and the Atlantic Ocean, and lying north of the Ohio river and the Norfolk and Western railway from North Kenova, Ohio, to, and including Norfolk, Va. It includes the region lying east of the Mississippi river (but including St. Louis), and Lake Michigan (but including Chicago), and a line following the Atcheson, Topeka and Santa Fe railway west from Chicago to Peoria, including Peoria, and thence proceeding west by the east bank of the Illinois river to the Mississippi river. This classification consists of six numbers (1, 2, 3, 4, 5, and 6), Rule 25, which is 15 per cent below second, Rule 26, which is 20 per cent below third, and seven whole number and fractional multiples of first.

The Southern classification includes the territory south of Official territory, and east of the Mississippi river, except that intra-state rates in Virginia, and in Florida and Alabama are classified by state commissions. This classification is composed of six numbers and four letters,—1, 2, 3, 4, 5, 6, A, B, C, D—with six multiples of first class.

The Western classification includes that portion of the United States lying west of Official and Southern territory. It is composed of five numbered and five lettered classes,—1, 2, 3, 4, 5, A, B, C, D, and E—and seven multiples of first.

Since December 30, 1919, these three classifications have been published in one compend, known as the Consolidated Freight Classification. This consolidation gives one description, in place of three, as the basis of classification. The C. F. C No. 4, issued December 20, 1924, and effective February 10, 1925, contains 422 pages of descriptions and rates. In all, there are many thousands of class determinations, and new ones are constantly being added

The classification of an article depends not only upon its nature but upon the method of packing, crating, and boxing used, and upon whether or not the shipment is a carload. Classification committees influence rates, not only by assigning articles to classes, but by fixing the allowable minimum carloads, by determining the status of mixed packages, mixed shipments and mixed carloads, by fixing private car mileage allowances, and by determining the precise nature of the various stipulations contained in the uniform bill of lading

The Rate Structure.—The classification being completed, the next step in rate making is for the individual roads to fix the rates to be charged for moving the different classes of freight between the stations on their lines. The carriers also enter into joint rate agreements with each other on through business. A railroad may withdraw an article from its class and provide for it a special or commodity rate. This power has been exercised so freely that there are in existence hundreds of thousands of such special rates As a rule commodity rates are lower than the class rates they are applied chiefly to low-grade materials which are moved in large quantities

Local and non-competitive freight rates are, in general, modified mileage tariffs, influenced by distance but responding in a less and less degree to it as distance increases.

Through rates are competitive adjustments between markets and between rival carriers. The initial through rates, which fix the bases for all others, are those between the great cities, and those which are established where the competition of ocean, lake, canal, or river carriers sets a definite maximum to rail charges. The determination of initial or base rates results in the establishment of certain places as basing points. Nearby points, or points highly competitive with the basing points, tend to take this base

rate, and so to become common points with the basing point. The rates for other localities within the influence of the basing point, but so far removed, or so unimportant, that competition does not bring about a parity, will usually be adjusted either as a percentage more or less than the base, or as an arbitrary sum or fixed differential more or less than the base.

Rate Structure in Official Territory.—In Official territory the foundation on which all other determinations are based is the rate between New York City and Chicago. Direct railway routes are made full rate or standard: the round-about ones, and the lake, ocean, and canal combinations are lower differential routes. The chief inland cities between New York and Chicago take rates composed by adding to a fixed terminal charge a mileage charge proportional to the distance. Such rates are represented in practice as a percentage of the through rate, and are applied, finally, throughout narrow zones embracing a series of north and south points, the north and south carriers having frequently forced the boundaries of the zones to lie just west of their lines. Pittsburgh and Buffalo take 60 per cent of the Chicago-New York rate. Youngstown takes 67 per cent, Cleveland 71, Columbus 77, Detroit 78, Cincinnati 87, and Indianapolis 93 per cent. The even Chicago rate, or 100 per cent, applies to a zone which passes southeasterly through Indiana to Louisville, Ky. Beyond this zone St. Louis takes 117 per cent, while Cairo and other Mississippi river points, north and south of St. Louis, take 120 per cent. East of the Buffalo-Pittsburgh zone, there are many modifications of the percentage bases, somewhat in the direction of common point basing.

The Atlantic ports are balanced in their relations to each other by carefully measured fixed differentials: Baltimore and Philadelphia being given a few cents per 100 pounds advantage over New York. The port differentials, in turn, condition rates west from and east to nearby places· the Philadelphia rate applies to Wilkes-Barre; the Baltimore rate applies to Altoona, Newport News, Norfolk, and to the chief inland cities of Virginia.

New England is charged on east-bound shipments, originating west of Buffalo, Pittsburgh, and Wheeling, a few cents over the New York rate, this rate being blanketed over all of New England. For shipments out of New England westward to points in 67 per

cent territory or beyond, the New York rate is charged Rates to points east of 67 per cent territory are higher than the New York rate

Commodity rates east-bound and west-bound in Official territory, in general, follow the relative adjustments of class rates.

Local rates in Central Freight Association territory (roughly Ohio, Indiana, Illinois, and Michigan) are modified distance scales, recognizing mileage in blocks of 5 miles to 100, in blocks of 10 miles to 300, and in blocks of 20 miles beyond 300. Lower clases, at all distances, take the same percentage of the first class rate, for the particular mileage Territory is divided, on the basis of traffic density, into zones A, B, C, D, E, and F, the zone rates grading up from A rates by fixed arbitraries or percentages. Local rates in New England are similar modified distance scales, northern New England having rates 10 per cent above southern New England.

The rates in Official territory are now under investigation by the Interstate Commerce Commission Docket No. 15,879. It is probable that many rates will soon be changed, to bring the local and the through rates into better adjustment.

Rate Structure in Southern Territory.—In Southern territory, freight rates along the Atlantic seaboard are dominated by the charges of ocean carriers, the base rate being that between Baltimore and Savannah. This is built upon in the north by making the Potomac gateways equal with Baltimore, the Virginia ports differentials less, and the Atlantic ports north of Baltimore differentials more. The Southern ports are similarly adjusted, Charleston taking a differential less, and Jacksonville a differential more Interior territory uses through rail-and-water rates erected upon these bases.

In the construction of all-rail rates, Southern territory is classified as differential or non-differential. The differential region has, as its western boundary, a line drawn through Knoxville, Chattanooga, thence via the Alabama Great Southern railway to Birmingham, thence by the Louisville and Nashville railway to Mobile. In this territory all-rail rates to and from Northern ports may be a differential above the rail-and-ocean rates In non-differential territory, which lies to the west of the line given, all-rail and rail-and-water rates are the same In the middle south,

a region south of the Alabama and Vicksburg railway has gulf-ocean-and-rail rates to northern ports which are lower than all-rail rates.

The all-rail base in the eastern South is the rate between Baltimore and Atlanta.

In the North this is built upon by giving to the eastern seaboard cities fixed differentials above the Baltimore rate, and by constructing back of each port a small common-point territory. In the South a few cities are made common points with Atlanta, while other important cities are given a differential either over or under the Atlanta rate, depending upon their relative rates to the southern ports.

In bringing the Northwest and the eastern South into relation, the first step is to equalize competition between the East and West. This is done by making the rate from all Ohio river crossings to Atlanta the same as the Baltimore-Atlanta rate. Cities north of the river add to the Ohio river rate the lowest rate to the river, no matter which crossing the freight actually uses. St. Louis has the river rate plus a differential, while Memphis subtracts a differential from it. The central South takes rates from the Northwest which are differentials lower than the Atlanta rate. Freight moving into the Northwest from the South is composed chiefly of a few products, and is controlled by commodity tariffs.

Local traffic in the South is much less in proportion to through traffic than in the North, and local rates are higher and more closely approximate to true distance tariffs. Intra-state rates in Virginia, North Carolina, South Carolina, Georgia, Florida, and Mississippi are controlled by state railway commissions. Formerly southern local rates were generally fixed upon the basing point system, by giving to the less important localities rates found by taking the combination to and beyond the last intervening important point, or to and back from the next basing point beyond, whichever was the lower. This condition has been changed for many districts in the South by decisions of the Interstate Commerce Commission, which is gradually dissolving the basing point structure, and substituting rates which are in conformity with the long-and-short haul rule. The Southern rate system is now under investigation by the Interstate Commerce Commission: Docket

No 13,491. It is to be expected that fundamental changes will presently be ordered.

Texas Rates.—For connections with the outside world, most of eastern Texas, except for a district around Dallas and Fort Worth, which is slightly favored, is a common point territory. Into this region gulf-and-sea rates from the East, via Texas ports, and all-rail rates via St. Louis, are adjusted upon a competitive basis. The St. Louis rate is then extended to a few competitors like Kansas City; while cities like Louisville, Cincinnati, and Chicago add a differential, and those like Memphis and New Orleans take one off. Out of this region the rates are quoted to "defined territories," of which those to the north east are based upon St Louis, adding or subtracting a differential, while those to the north are based upon Kansas City.

Texas internal rates are modified distance tariffs up to certain points beyond which, depending upon the commodity, and ranging from 200 miles to over 400 miles, they cease to increase From these points on, the tariffs are flat rates, regardless of distance. These rates, established by the Railroad Commission of Texas, are intended to assist in knitting the state into a unit commercially.

Western Rate Structure.—East and west movements beyond Chicago are based upon adjustments between the Mississippi river and the Missouri river, and upon St. Louis and Chicago bases. For through traffic, the rates by way of Mississippi river points from St. Louis to Dubuque, both inclusive, and by way of Missouri river points from Kansas City to Sioux City, both inclusive, are very closely adjusted. Chicago reaches the Missouri river points for a differential over St Louis. St. Paul and Duluth carry a differential above the Chicago rate· while Memphis reaches Kansas City for a differential over the St. Louis rate. From Trans-Missouri territory, eastward, the St. Louis rate is basic. Chicago, Duluth, Peoria, and St. Paul are reached by adding differentials to the St. Louis rate.

For through rates Colorado is largely a common point territory, which includes Denver, Pueblo, Trinidad, and many smaller places. These common points have a base rate, to and from the Missouri river, determined by the Interstate Commerce Commission This is built upon in the West by creating differential regions around the common point territory; while in the East, territory

to the Illinois-Indiana boundary is divided into 16 groups, St. Paul and the Mississippi river points being on a parity, while Chicago, Duluth, and Memphis are on a parity. Colorado merchants are given entrance to western Kansas and Nebraska by rates which, according to the territory involved, either do not exceed, or exceed by a small percentage only, rates westward from Missouri river points.

Utah common points are related to the East in much the same way as the Colorado common points. For shipments from the Missouri river or from further east, the charge to Utah is less than the Denver rate plus the local charge to destination This arrangement is made to permit Utah points to compete in the territory lying between them and Colorado points. The leading cities of Utah from Spanish Fork to Ogden are common points with Salt Lake City, for through shipments.

Rates to Montana common points, including Butte, Anaconda, and Helena, are based upon Spokane and Utah common points. Chicago reaches Utah and Montana common points at the same rate. St Louis and Mississippi river points take the Chicago rate; while St. Paul and Missouri river rates are lower.

Transcontinental Rates.—West-bound California class rates recognize, in the east, a series of nine zones, into which the country east of Colorado common points is divided; while upon the coast, California is divided into terminal-point territory, and an intermediate territory which extends as far east as Utah common points. The intermediate district takes rates which are lowered, step by step, eastward from terminal rates to Utah common-point rates.

West-bound class rates to the North Pacific region, recognize zones very similar to those used for California class rates. Rates to intermediate districts, advance from the Spokane rates, step by step, westward, until the terminal rates are reached. East-bound class rates are very similar in construction to west-bound class rates.

Transcontinental west-bound commodity rates are based upon the activity of Panama canal traffic, and upon Panama canal rates. In general, they specify a smaller number of western termini, and they blanket the region east of the Missouri river. East-bound commodity rates usually are blanketed to all destinations.

Influence of the Rate System.—The general effect of the American rate system is to favor large cities at the expense of

small ones; to favor localities in which much of a given kind of freight originates in comparison with localities with a wider range of production; to favor certain articles which move at commodity rates at the expense of other things which are charged according to their class; and to favor shippers who possess such facilities as switches, switching engines, and short private lines, or private freight cars, in comparison with those who use the agencies provided by the carriers.

The traffic manager should watch carefully for the rise of such adverse competitive conditions as will justify a change of classification or the issue of a commodity rate on any of his company's inbound raw materials or outbound finished products. The petition for a change of classification should be addressed to the classification committee of the territory. Such a petition should recite the pertinent facts such as the relation of bulk to weight; whether the article is crude, partly manufactured, or finished; whether it is shipped loose or packed, set up or knocked down, crated or boxed; the market values in different localities, especially at shipping and destination points; the length and direction of the haul, the time of year carried, the amount of traffic likely to offer itself, and mention of any special labor required to handle it, or any special risk of loss incurred in transit

The case for the granting of a commodity tariff, or the change of rate of such a tariff, has to be presented to the rate-making officer of the individual railroad, usually the traffic manager or the general freight agent. The petition should elucidate the competitive conditions controlling trade in the article concerned, indicating the producing and consuming centers, giving the freight rates at which rival producers reach essential markets, and stating the rates the petitioners require in order to reach those markets on equal terms.

Packing.—The nature of the package and the method of packing exert a decisive influence upon the freight rate charged. The necessity for extra charges for poorly prepared merchandise can be seen when it is known that in 1924 there were 2,498,790 loss and damage claims filed with American railways, and that on them there was paid to shippers the sum of $48,262,543. Of this amount $28,488,128 was paid on account of damage during shipment.

Item	Articles	Official	Southern	Western
1	**Disinfectants, other than medicinal, N O I B N**			
2	**Liquid**			
	In carboys, necks projecting, L C L	1	1	1½
	In carboys, completely boxed, see Note, L C L	1	1	1
	In carboys, C L, min wt 24,000 lbs, subject to Rule 34	3	4	3
	In earthenware packed in crates	1½	1	1
	In glass or earthenware packed in barrels or boxes, L C L	1	2	2
	In glass or earthenware packed in barrels or boxes, C L, min. wt 30,000 lbs	3	6	5
	In metal cans partially jacketed, L C L	1	1	1½
	In metal cans completely jacketed, L C L	1	2	2
	In metal cans in barrels or boxes, or in bulk in barrels, L C L	3	3	3
	In metal cans partially or completely jacketed, in metal cans in barrels or boxes, or in bulk in barrels, C L, min wt 30,000 lbs	5	6	5
3	Note—Carboys must be completely boxed and boxes plainly marked on top, "Top—load this side up."			
10	**AGRICULTURAL IMPLEMENTS, HAND**			
11	**Cultivators, Drills, Fertilizer Distributors, Hoes, Mulchers, Plows, Rakes, Seeders or Weeders, separate or combined, wheeled**			
	S U, loose, L C L	D1	1½	D1
	S U, in boxes or crates, L C L	1½	1	1½
	K D flat, in bundles, L C L	R25	2	2
	K D, in boxes or crates, or handles in bundles, L C L	R25	3	2
	S U or K D, loose or in packages, C L, min wt 24,000 lbs, subject to Rule 34	5	6	A
13	**VEHICLES, CHILDREN'S, see Note 1**			
14	Note 1—Axles may protrude from boxes or crates			
15	**Automobiles, Carts, Hand Cars or Children's Vehicles, N O I B N**			
16	**S U, wheels on or off**			
	In boxes or crates, L C L	3t1	D1	D1
	In packages named, C L, min wt 10,000 lbs, subject to Rule 34	2	2	2
17	**K D**			
	In boxes or crates, L C L	1	1	1
	In packages named, C L, min wt 15,000 lbs, subject to Rule 34	3	3	3
18	**S. U and K D**, in boxes or crates, mixed C L, min wt 15,000 lbs, subject to Rule 34	3	3	3
19	**Carriages, Go-Carts or Sulkies, Baby or Doll, see Note 2**			
20	**Collapsed, folded flat or K D. flat**			
	In boxes or crates, L C L	2	2	2
	In packages named, C L, min wt 20,000 lbs, subject to Rule 34	4	4	4
21	**Other than collapsed, folded flat or K D. flat**			
	Wheels on, in boxes or crates, L C L.	3t1	3t1	3t1
	Wheels off or completely drawn into body, in boxes or crates or in bundles completely wrapped in fibreboard, L C L	1½	1½	1½
	In packages named, C L, min wt 10,000 lbs, subject to Rule 34	2	2	2
22	Note 2—Sulky handles may be in bundles.			

Item	Articles	Official	Southern	Western
19	Crates, wooden, N O I B N			
20	New			
21	S U			
22	Not nested			
	Loose or in packages, L C L	D1	1	D1
	Loose or in packages, C L, min wt 12,000 lbs, subject to Rule 34	R26	4	3
23	Nested			
	In boxes, bundles or crates, L C L	1	2	1
	Loose or in packages, see Note 2, C L, min wt 18,000 lbs, subject to Rule 34	4	5	4
24	Nested and not nested, loose or in packages, mixed C L, min wt 18,000 lbs, subject to Rule 34	4	5	4
25	Folded flat or in flat sections			
	In bundles or crates, L C L	4	4	4
	Loose or in packages, C L, min wt 30,000 lbs	6	6	B
	FURNITURE, see Notes 1 and 2—Continued			
	Metallic or Wooden, see Note 9—Continued			
	Chairs, see Note 20—Continued			
1	**Revolving, N O I B N**			
2	S U			
	Wrapped in burlap or paper, L C L	D1	D1	D1
	In boxes or crates, L C L	D1	D1	1½
	In packages named, C L, min wt 10,000 lbs, subject to Rule 34	2	3	3
3	Tops and bases separated or base reversed on screw			
	Wrapped in burlap or paper, L C L	1½	1½	1
	In boxes or crates, L C L	1½	1½	1
	In packages named, C L, min wt 14,000 lbs, subject to Rule 34	R26	3	3
4	K D flat			
	In boxes, bundles or crates, see Note 3, L C L	2	2	2
	In packages named, C L, min wt. 24,000 lbs, subject to Rule 34	4	4	4
	SUGAR			
17	**Corn**			
18	**Granulated or powdered**, in single bags complying with Note 2, in double bags, or in barrels or boxes, L C L	R26	5	4
19	**Other than granulated or powdered**, in bags, barrels or boxes, L C L	R26	5	4
20	**Granulated, powdered, or other than granulated or powdered**, in packages named, or in cakes or slabs, C L, min wt 40,000 lbs	5	5	5
21	Note 2—Ratings will apply when the bag is made of cotton cloth weighing not less than 7½ ounces per square yard and having not less than 65 threads to the square inch, including the warp and filling, and of tensile strength not less than 65 lbs in the warp and 68 lbs in the filling, or when the bag is made of single cropped and mangled or double calendered burlap weighing not less than 10½ ounces per yard, 40 inches wide, and counting not less than 11 porter (warp) and 12 shots (filling), tensile strength to be not less than 61 lbs in the warp and 68 lbs in the filling			

FIG. 50.—SAMPLES FROM CONSOLIDATED FREIGHT CLASSIFICATION NO 4, SHOWING HOW METHODS OF PACKING INFLUENCE FREIGHT RATES.

The freight classification shows that a spread of one class, and sometimes more, separates shipments set up and knocked down, and nested or not nested. Rule 40 of the Consolidated Freight Classification provides that when containers are of the same general description as those called for in the rules or in the descriptions of articles, but do not strictly comply, the rate shall be one class higher. Crates subject articles to one class higher than barrels or boxes, while pails, kits, or tubs are two classes higher, and bags, bundles, and baskets three classes higher.

Classifying and Grouping Commodities.—The necessity of classifying shipments, in order to obtain favorable freight rates, is amply demonstrated by the rules of the classification committees. Rule 12, Section 3 of Consolidated Freight Classification No. 4 is: "The charge for a package containing freight of more than one class shall be the rating provided for the highest classed freight contained in the package" A shipment can often be divided to advantage; the high-rate articles being packed and shipped separately from those which take a lower rate.

It is not sufficient to describe goods by trade names or general descriptive phrases. Precise descriptions are contained in the classification, and agents are not at liberty to force shipments into classes for which the descriptions do not fit. It is obvious that a traffic manager, who is familiar with billing terminology, can honestly describe his shipments in making out the bills of lading, and yet secure transportation at rates materially lower than would be assessed if the designations were vague and general.

The class and commodity tariffs all contain specifications as to the minimum weight to be charged for at carload rates. These weights should, of course, be actually shipped where possible, when paid for.

Carload shipments are not only carried at lower rates, but they give the shipper and consignee control of the car and the opportunity to put private seals upon it, as well as supervision over cleaning the car, stowing the merchandise, etc. Carloads are advanced more rapidly than less than carloads. By reason of the private loading and unloading, and the sealing of the car for the trip, and the elimination of unloading and reloading operations at transfer points, the loss and damage hazard is very much reduced. Carload shipments can be easily routed, and the routing instruc-

tions are likely to be observed; so that the whereabouts of a carload shipment is at all times reasonably well known. Such a shipment is easily traced, as the identity of the car is known.

Marking and Billing.—Each package, not in a carload shipment, should be legibly marked with the name of the consignee, if on 'straight' bill, or the name of the shipper, if on 'order' bill; and with destination so fully given that it is impossible, with reasonable care to mistake it. The marking should be done in such a way that it is practically certain that it will not become obliterated or separated from the merchandise. Care should be taken to see that the marks on the packages agree with the shipping instructions and bill of lading. Instructions for marking will be found in Rule 6 of the Consolidated Freight Classification

The shipping instruction and bill of lading should be made out with care, legibly, with full names and addresses, with accurate descriptions, with the numbers and marks of all packages, and with full instructions. The straight bill of lading is made out to the consignee, and permits him to secure the merchandise even without the bill. The order bill of lading is made out to the shipper or his order, and under it no one but the shipper, or the parties designated by his written order, can obtain the shipment; and then only upon the surrender of the bill of lading to the carrier. Normally, the consignee obtains the order bill of lading from a bank, after paying or accepting an accompanying draft. Both bills of lading have the terms of the contract into which the carrier enters printed in full upon the back. As these terms have a vital relation to liability for loss, damage, and delay, and prescribe the procedure to be followed by shipper and carrier in a variety of contingencies, they should be thoroughly understood by the shipper.

Routing of Shipments.—The shipper has an undoubted right to control the route by which his shipment shall travel to its destination, within the limits of the connections which the initial carrier is bound by law to make. He has also the privilege of access to all railway rates in force, for the law prescribes the manner in which these tariffs shall be published, and the places at which they shall be filed. But, unless the shipper has knowledge that a through rate is in force by the route he selects, he may have the

disagreeable experience of incurring a succession of local rates Nor is the shipper entirely secure when he has from an agent in writing the statement of a rate; for the position has been taken, and confirmed by the Interstate Commerce Commission, and the courts, that there is at any one time in existence but one legal rate for a given transportation service, and that is the published rate. By no means, accidental or intentional, can a carrier establish any other rate. It is a safe rule not to specify intermediate routing, unless the shipper is satisfied as to the rate. When no routing is specified the railways are obliged by law to route (according to the class of carriers designated, as all rail, rail-and-ocean, rail-and-lake, etc.) so that the lowest freight charge will be incurred. If then there is mis-routing, the shipper has a valid claim for the amount of the extra charge.

Some of the considerations which will influence the traffic manager in determining intermediate routing are, experience with reference to speed, the number of transfers, with consequent hazard of loss or damage, the ease or difficulty of tracing freight, the restriction of terminal facilities at point of destination by reason of the rules of the line-haul carrier as to absorption of switching charges, the promptness with which claims are paid, the cost of trucking to and from terminals, etc. When it is realized that the Chicago switching district is 28 miles long and 12 miles wide, that it is entered by 22 trunk lines, and served by 5 belt carriers, and that it contains 105 stations from which less-than-carload freight may be delivered, the necessity of considering the convenience of the terminal can be seen.

Package Car Service.—For less-than-carload shipments, the traffic manager will desire the fullest information with reference to package car service. This service has grown rapidly in recent years, as a result of the practice by manufacturers of making direct sales to retailers, and of the parallel practice of small-scale frequent ordering by retailers from manufacturers and from local jobbers. In June, 1925, the New York, New Haven, and Hartford railway was operating 5577 package cars of its own origin a week, of which 3900 were local cars between points on its own lines, while 1677 were inter-line cars moved to junction points and forwarded to the great transfer yards of other railways. From the Cedar Hill Transfer of the New Haven rail-

way, 33 cars were sent out daily, and 14 additional ones three times a week, to 40 transfer points on 15 railways

At St. Louis, the regular service of package cars provided by 19 railway systems, reaches directly without break-bulk, 474 different stations, either daily or several times a week. From these break-bulk points most of the cars travel on, serving a series of localities, so that in all from 5 to 10 times as many freight station stops are served.

The Rate of Freight Movement.—It is desirable to know approximately the progress which shipments will make, so that consignment can be timed to conform to fixed delivery dates, so that reconsignment notices can be filed on time, and so that tracers shall be withheld until reasonable time has elapsed. The rate of movement on the Atchison, Topeka, and Santa Fe railway for the transcontinental haul, from Chicago to Los Angeles and San Francisco, is a little above 11 miles per hour, while on the green fruit trains eastbound from California the rate approaches an average of 15 miles per hour. For fresh meat from Missouri river points to the Santa Fe connections with eastern lines, the rate is about 17 miles per hour; while live stock shipments, destined to reach a certain market, make an average speed (including stops) of 18 to 20 miles per hour.

Fast manifest trains between New York and Chicago are on a 72-hour schedule, which makes the approximate advance from $12\frac{1}{2}$ to $13\frac{1}{2}$ miles per hour, according to the route. Considering the average of all classes of freight, the records for the month of April, 1925, for the New York-Chicago shipments, indicate an advance of 26.5 miles per day.

Package cars from Peoria, Illinois, in the next day after departure, reach 18 cities in a circle having an average distance from Peoria of 133 miles. The distances reached vary from 91 miles to Moline and Rock Island to 172 miles to Logansport. In the second day out from Peoria, package cars reach 35 cities at an average distance of 314 miles, ranging from 143 miles to Beloit to 463 miles to Traverse City. The entire performance of these cars indicates an advance of approximately 6 miles per hour.

Bulked Shipments.—There are two systems of distribution which have been in competition. One employs carloads from manufacturer to local jobber, and L. C. L. shipment from jobber

to retailer. The other uses L. C. L. shipments directly through from manufacturer to retailer. It is obvious that the second system is at a disadvantage from the traffic standpoint. To improve it, there is coming into use the method of bulking shipments, which would otherwise go forward L. C. L. to a variety of retailers, into carloads, and sending them through to centrally-located warehouses, where the bulk is broken, and the merchandise is reconsigned on new bills of lading to retailers. It is but a step from this idea to sending forward carloads of merchandise to the warehouse to form a spot stock, from which shipments will be made to retailers upon orders received from the home office by mail or telegraph.

Freight Claims.—The railways are liable for loss, damage, wrong delivery, delay, and overcharge, together with interest on the sums involved. The responsibility is limited to direct losses; that is to say, if the paper of a daily newspaper were lost, the responsibility of the carrier would be for the value of the paper, and not for the indirect and consequential injury which might result from suspension of publication. Delay beyond a reasonable time involves responsibility where there is a discrepancy between the market value of the goods at the time actually received and the value at the time they should have been received. The responsible railway is the one issuing the bill of lading. Liability is to the consignee in the case of a straight bill of lading; to the consignor, or person to whom he endorses, in the case of an order bill of lading.

When damaged or short shipments are received, the proper procedure is to accept the freight, upon the proper notation being made by the freight agent upon the receipted bill, and then to file claim. In case of concealed damage or loss, notice should be given to the agent in writing at the earliest possible moment, and an opportunity offered him to make inspection. Claims for shortage often involve the meaning of the endorsement "shipper's load and count" on the bill of lading. The use of this phrase does not constitute a waiver of the shipper's right to recover for shortage, but it does lay upon him the burden of proof that the quantities claimed were actually delivered to the railway. In such a case a set of business-like records made by the packers, checkers and truckers is of great assistance.

The most difficult claims to adjust are those involving concealed loss and damage. A suggestion for locating responsibility in cases involving concealed loss (and also for preventing loss) has been made by Mr. W. H. Chandler, Manager of the Traffic Bureau of the New York Merchant's Association. He says: "If the shippers would use a paper seal,coated on one side with a good adhesive, and printed with an ink that would run if dampened, the seal carrying words to the effect that if seals indicate tampering in transit the shipments should not be accepted unless checked in the presence of the representative of the delivering carrier, one uncertainty as to where losses occur would be removed."

Another suggestion comes from the Eastman Kodak Company. When this company has a claim for shortage, the packers who put up the original order are called upon to lay out an order which is an exact duplicate. These goods are then packed in the customary manner, in boxes or cartons exactly like those used in the original shipment, and of which a record is kept. The newly packed goods are then weighed, and the weight compared with the record of the weight of the original shipment. The next step is to remove the items claimed to have been missing, and reweigh the order. A comparison of the weights should indicate whether or not there was a shortage when the original order left the factory.

The Motor Truck versus the Railway.—The field of the motor truck lies between that of the horse-drawn vehicle and that of the railway. As the motor truck when standing involves a greater hourly loss than a team, and when in motion a greater mileage cost than a railway car, the principle of economics is to use teams for short distances and routes with many stops, and railway cars for long hauls. Experts now place the province of the team within a 6-mile radius, that of the motor in an area between a 6-mile and a 35-mile radius, and that of the railway in territory beyond 35 miles. A circumstance limiting the motor is the heavy charge incurred when the driver must be away from home over night.

PROBLEMS

The Geography of Freight Charges.—Upon a large scale map of the territory within 100 miles of your local city, indicate all of the railway lines, and locate the position of all freight station stops. Secure from the local freight offices, representing the various lines, the freight rate to

each station for 100 lbs of first class freight Having entered these data upon the map, draw a series of lines connecting the stations taking the same or nearly the same rate, and in such a way that there will be five or more freight rate zones indicated, the zones representing approximately equal spreads in charges.

This being done, construct a companion map of the same size, lay off a series of concentric circles (true circles) with your locality as the center, to represent freight costs, and spaced at distances from the center proportional to the quantities of the freight charges represented by the lines on the first map Next indicate the localities and other natural features in proper relation (upon a freight-cost basis) to these concentric circles, thus revising the physical or distance geography into a freight-cost geography

The Geography of Transportation Time.—The data given in the list of localities, in this project, indicate the days required for package car shipments to arrive from Cincinnati, Ohio

One day Toledo, Van Wert, Wayne, Marion, Ind , Lafayette, Indianapolis, North Vernon, Vincennes, Cynthiana, Louisville, Danville, Somerset, Corbin, Ashland, Huntington, Parkersburg, Columbus, Marion, O

Two days Detroit, Jackson, Grand Rapids, Logansport, Chicago, Bloomington, Peoria, Danville, Mattoon, Decatur, Springfield, East St Louis, Paducah, Memphis, Jackson, Tenn., Clarksville, Hopkinsville, Nashville, Birmingham, Montgomery, Chattanooga, Rome, Atlanta, Knoxville, Bristol, Charleston, Clarksburg, Wheeling, Pittsburgh, Allegheny, Canton, Akron, Buffalo, Cleveland, Sandusky

Three days Saginaw, Mackinaw City, South Bend, Milwaukee, Kansas City, Cairo, Little Rock, Vicksburg, Meridian, Mobile, Selma, Macon, Jacksonville, Savannah, Asheville, Spencer-Transfer, N. C , Lynchburg, Norfolk, Newport News, Richmond, Charlottesville, Strausburg, Harrisonburg, Baltimore, Camden, Philadelphia, Harrisburg, Wilkes-Barre, Scranton, Binghamton, Albany, Rotterdam, Utica, Syracuse, Rochester.

Four days· Madison, Wis , St Paul, Minneapolis, Albert Lea, Dubuque, Cedar Rapids, Des Moines, Ottumwa, Kirksville, Springfield, Mo , Jackson, Miss , Columbia, Georgetown, S. C., Raleigh, Henderson, Washington, D C , Reading, Allentown, Newark, New York, Boston, London, Ont , Erie, Pa , Traverse City, Mich

Upon a large base map, showing that portion of the United States east of Kansas City, find the localities mentioned in the list, and indicate at each by a numeral the day upon which freight arrives

Connect the localities having the same arrival time by lines, thus dividing the map into a series of irregularly shaped zones By this means there is produced a time map upon a geographical or distance base

This being done, construct a geographical or distance map upon a time basis, by laying off from Cincinnati as the center, a series of equi-

distant concentric circles representing days of car transit Upon the areas divided by these circles plot the localities in the above list, and finally draw in the natural features, such as state, ocean, and lake boundaries, in proportion

Correct Billing and Packing.—Select from the Consolidated Freight Classification certain illustrative descriptions of freight, and designations as to packages, methods of packing, etc , to show the importance of correct description of freight shipments, and to indicate the expense which poor packing and preparation for shipment may cause a shipper

Demurrage.—Draw up a report upon the leading principles underlying the National Car Demurrage Rules, with an explanation of the nature of the averaging agreement permitted

Reference.—National Car Demurrage Rules as shown by the latest tariff issued by the American Railway Association, Traffic Bureau, Chicago, Ill

Transit Privileges.—Explain the different types of transit privileges granted by the railways, and indicate the restrictions placed upon their use

References —Tariff circulars dealing with Transit Privileges may be obtained from the general freight agents of the larger railway companies Local freight agents may have copies of some of them

Diversion and Reconsignment.—Draw up a report upon the nature of the privileges of diversion and reconsignment for carload and less-than-carload shipments, granted by the railways.

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Map of Junction and Terminal Points in C. F. A. Territory and Adjacent Junction and Terminal Points, 38×30 ins.
Map of Percentage Groups in C. F. A. Territory for Eastbound Freight Rates, 40×42 ins
Map of Percentage Groups in C. F. A Territory for Westbound Freight Rates, 40×42 ins.
Map showing Groupings of Eastern and Middle Western Points on Traffic Destined to Transcontinental Freight Bureau Territory, 26×38 ins.
Map of Southbound Rate Groups in Trunk Line Territory, 40×42 ins.
Map of Eastbound Rate Groups in Trunk Line and New England Territories, 40×42 ins.
Map of Westbound Rate Groups in Trunk Line and New England Territories, 37×41 ins.

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CHAPTER XXVII

CREDIT AND COLLECTION

Commercial credit is the sale of merchandise on the promise of future payment. It rests upon confidence in the ability and disposition of the debtor to fulfill his obligations. To give to another person credit means to make a short-time investment in his business; to stake one's money on the location and methods and talent of a particular firm, as over against competitors Credit permits men who have more property than opportunity to aid those who have more opportunity than property. It is one of the greatest of the economic agencies by which capable men are selected out from among their less competent competitors, are furnished with resources, are given enlarged opportunity, and are aided to perform a larger service for themselves, their backers, and the community at large. To give credit with care means to encourage honest and capable men as proprietors of business, and to discourage those who are dishonest or incapable.

The capital of a trading corporation is largely in the form of quick assets, which are subject to high rates of depreciation and obsolescence, and are easily dissipated. Such security is not appropriate to serve as the foundation for issues of long-term obligations. There is little if any room for the pure investor. The funds for such enterprises should come from the owner-managers (partners or stockholders), from the local banks, and from mercantile houses which are prior in the chain of commodity distribution: from owners, because they can protect their property by their personal efforts in management, and because their hazard is in anticipation of a profit; from local banks because, by reason of proximity and first-hand knowledge of current financial transactions, they have an opportunity to keep informed, and their losses can be averaged and added to the cost of doing business; from mercantile houses, because in connection with the process of supplying commodities, they can collect information,

and their losses can be averaged, and offset by an addition to prices.

The General Credit Policy.—The policy used in extending credit and in making collections should be harmonized with the remaining body of policy of the business establishment. An enterprise with small capital will aim at rapid circulation of its assets by offering liberal discounts for cash, by energetic treatment of slow accounts, and by the use of trade acceptances or dealer's notes which can be discounted. An industry with a marked seasonal irregularity will be inclined to develop the practice of giving long terms, to induce advance ordering, while yet obligating customers to pay their bills as they realize upon their stocks. An establishment in an out-of-the-way location will see that it can devise easy terms for distant territory, and so practice market equalization by means of credit as well as by absorbing excess freight charges. A new firm will seek to grow with rapidly growing territory, by distributing its credit favors in young neighborhoods, and with new firms.

Relation of Credit to Terms of Sale.—Credit is influenced by many of the terms of sale; and credit considerations must necessarily dictate many of them. This is particularly so with reference to discounts for prompt payment, datings, the requirement of evidences of debt which can be discounted, and the withholding of the passage of title until payment is made in full.

The interest calculations involved in payment have to do with discounts offered for anticipation, or for prompt payment, and with the interest charge exacted as a penalty for delay. The majority of the concerns which sell to dealers allow a discount for payment within a few days after the date of the bill. The most frequently employed terms are, "2–10–30–6," which mean 2 per cent discount for cash in ten days, and interest at 6 per cent after 30 days. This allowance for payment in 10 days is at the rate of 73 per cent per annum: a rate which stands in marked contrast to the 6 per cent per annum designated for the overdue account. The rate of the cash discount cannot be justified, therefore, as interest for the use of the money for the period. Credit-giving concerns are able to borrow money at a fraction of this rate; and the debtor business which is sound and well managed can borrow money with profit to discount its bills.

The high rate of discounts is intended to stimulate debtors to prompt action, and so prevent accounts from slipping into that "old" stage where they are hard to pay. In so far as the psychology of debt paying is concerned, obligations are easiest met when incurred, for at that time the sense of contract obligation is strongest, and the value of the merchandise received is most vividly realized. At that time, also, the inflation of assets caused by the receipt of new units of capital in the form of goods has not yet exerted a palpable influence toward affluent methods of finance, from which it is hard to return to the more cramped calculations of doing business on one's own capital.

"It may not be true," said Francis A. Walker, "that punctuality is the parent of all virtues; but unmistakably is procrastination the mother of every vice, whether in social or personal character. There is nothing for making duty easy like bringing men sharply up to it, and firmly holding them there. On the other hand, obligations grow heavier and heavier the longer they are put off. What was first procrastinated, it is soon sought to evade: self-respect wilts under the reproaches of the creditor; dishonest suggestions arise unrebuked in the mind that would once have thrust them indignantly out."[1] By making the fine for slowness a heavy one, the cash-discount system serves as a convenient touchstone of debtors, classifying them sharply into two groups, those who are standard and competent, and those who are sub-standard and who require a careful and costly nursing process.

A dating is an arrangement made at the time of a sale, for treating the bill as if the sale had taken place at a materially later date. The influence which, more than any other, keeps alive the pernicious practice of post-dating is the seasonal irregularity of trade. With post-dating often goes a special arrangement, distinct from the cash discount, for allowing a discount for anticipation or payment before the date of the bill.

A trade acceptance is a draft drawn on the buyer by the seller, to the seller's order, equal in amount and even in date with the invoice of a bill of goods, and sent to the buyer with the invoice, through a bank It calls for payment in a stated number of days

[1] Money in Its Relation to Trade and Industry, Francis A. Walker, N. Y. Holt, p 252

after date. When this draft has been countersigned by the buyer across its face as accepted, with the date, and the designation of the bank at which payment will be made, it becomes a note of the buyer. When endorsed by the seller and offered for discount at the seller's bank, it is two-name paper, entitled to a low rate of discounting, because it is a double obligation, and because it is acceptable for rediscount with the Federal Reserve banks. Long used abroad, the acceptance has come into use in this country since 1915. In essence, it is a plan for providing commercial paper, arising strictly out of mercantile transactions, which is acceptable to the banks for discount at a low rate of interest, so that an element of commercial financing previously performed by merchandise suppliers can be transferred to the banks.

The advantage of the acceptance accrues to the seller, for the acceptance is in the nature of a prompt authentication of an account, a means of releasing the seller's funds at will, and a means of passing a credit transaction under a banker's eye so that an independent fund of credit information is brought to bear. It is to be observed that the acceptance remains a contingent liability of the seller until it is paid, for it bears his name as well as that of the firm to whom the merchandise was sold. For the buyer, the acceptance creates a fixed obligation, less flexible in adjustment to his condition than the open book account, but permitting, by arrangement, prepayment or extension of time as may be required The use of the acceptance tends to eliminate the cash discount, and to lengthen the term between purchase and payment. It puts the buyer under the pressure of publicity with his banker There is a tendency to use the acceptance in a manner not originally contemplated by its advocates, namely, as a substitute for a promissory note, in the process of getting a past due account into better documentary form.

In some lines of trade, conditional sales are made as a means of facilitating the buyer's business with a supply of merchandise, without either receiving immediate payment or extending a credit. A conditional sale is one in which it is stipulated that the title to the merchandise does not pass to the seller until the merchandise is fully paid for, and that the proceeds of any sales of goods, as far as they can be identified, are also the property of the seller. Such an arrangement aims to safeguard sales to a buyer when the

throwing of the account in with the general mass of the buyer's obligations is considered to be unwise It is suited for merchandise sold by local agents rather than by true retail dealers. Conditional sales involve problems of registration, of maintaining the contract intact through the process of settlement, of proving the identity of the merchandise in case of fire or fraudulent transfer, and of procedure under the bankruptcy law.

Sources of Information.—The most authentic source of information available to the credit man is the description of his own financial state, and of his trade plans and prospects, given directly by the customer. The backbone of such a description is the "property statement," by which is meant the balance sheet and income or profit and loss account. The most comprehensive source of information is the ratings and special reports of the mercantile agencies. Next to this knowledge in value are the reports of traveling salesmen. The salesman's reports should supplement all other sources, and form a running fire of comment from the field, which serves to keep the credit histories of the home office revised to date. The salesman can help the credit department as no one else can do, by obtaining a property statement, when one is necessary as a basis for sales, by framing a clear and unequivocal contract of sale, by acting as an ambassador in settling difficulties with customers, and by reporting the appearance of the customer's place of business, the character and probable total value of the stock in trade, the evidences of volume of business, and matters of common report locally.

Other sources of information open to the credit man are bank reports which are reliable but reticent, since bank officials do not wish to perform the work of mercantile agencies. There are, also, the reports of organizations of local credit men, commonly known as credit clearing houses, the reports of credit bureaus of national trade associations, and the interchange of information which takes place by courtesy between the credit departments of different houses.

In recent years, it has become common practice for trade associations to collect and distribute credit information. As to the relation of this activity to the laws for the maintenance of freedom of trade, the present position appears to be that the activity is entirely legal, provided it is not coupled with efforts

to enforce uniform credit terms throughout the organization, or to establish a dead-line of elegibility for customers, or otherwise hamper free competition as to the credit terms of sales.

The Bases of Credit Personal Factors.—Credit rests upon the debtor's ability and disposition to fulfill his financial obligations. The debtor's ability depends not only upon his character and talents, but upon his property resources, and upon the general trade conditions, local and national, under which he works. We may classify the bases of credit, therefore, as three: the personal factors, the external conditions, and the property resources.

The importance of the one or two or three leading personalities in any business organization accounts for the interest which the credit man has in knowing who are the active and who are the sleeping partners, and what changes in the personnel of the partners has taken place or is in prospect. In the case of a corporation it is important to know of the sale of blocks of stock which pass control to new hands.

The study of the personality of the applicant for credit involves an inquiry into such matters as health, age, training, talent, application, economy, and fitness for the particular enterprise concerned. One-fourth of the failures are due to incompetence. It involves, also, the question of honesty—over one-tenth of the failures are due to fraud. As a result of the interviews which the credit man has with his prospective customer, he will ask himself: Has the customer confidence in himself? Is his education sufficient? What skill and persistency did he show in getting the line of credit he asked for? How good a grasp of the details and policies of his own business did he show? How well does he take care of his collections? What does he know about cost accounting; especially about such cost systems as are appropriate for his type of business? What does his conversation show with reference to his knowledge of general business conditions, and the trade prospects of his section in particular?

Time tests all things: so the credit man will desire to know how long a firm has been in its present neighborhood, and what length of experience in the business its managers have had.

The Bases of Credit: External Conditions.—To judge the general conditions of business which effect credit advances is not only to determine in what phase of the trade cycle the country is

at any time, and decide that the next phase is likely to be, but it is to review the prospects of a particular branch of industry, and to estimate the conditions which determine the prosperity of a locality. Some industries are in a state of speculative overdevelopment; others are involved in a general process of integration into large units which will crush out many small establishments; still others are being rendered obsolete by mechanical invention and the evolution of new methods of mercantile distribution. Some localities are cursed by non-periodic climatic changes which bring years of crop failure; others are single-line manufacturing districts, liable to be paralyzed by strikes, or to fall suddenly from prosperity into depression; still others are dependent upon a business of wasting assets, like lumbering or mining, which will eventually work out the local supplies and move elsewhere.

Sales on credit are to be paid for out of the proceeds of future sales. The man who sells on credit must foresee the conditions which will influence sales during the period of repayment. In judging of present and future general trade movements, the various financial services are now prepared to render valuable aid to the sales manager and the credit manager.

The Bases of Credit: Property Resources.—The ideal source of information on which to base a credit advance is the debtor's own statement: the heart of such a statement is a signed schedule of assets and liabilities. Applicants for credit are sometimes loth to give full information as to their affairs. On the significance of the statement in credit giving, the National Association of Credit Men says: "A merchant who desires to serve his own best interests should recognize that his most valuable possession, apart from his actual assets, is a sound, substantial and unquestioned reputation as a credit risk, and that, under the prevailing conditions and demands of business, the most effective, and eminently the best way to prove his basis for credit, is to be willing to submit a statement of his financial condition."

Honest persons should welcome a chance to put themselves upon a basis which those who have much to hide cannot attain. Those who are ambitious to rise should realize that it is profitable to establish confidence in the minds of those who have the means to aid them. There is every reason why the relations between a credit man and the customers of his firm should be a close and

candid one. The business interests involved are in natural accord, since a credit-extending house can only prosper through the prosperity of its customers. Furthermore, the credit man is the best financial doctor most business men ever have the privilege of coming into close touch with.

A complete financial statement is especially desirable from those who are placing a first order, from such as have no credit rating with a mercantile agency, or who claim that their rating is unjust or out of date, from customers who desire to place a new order before an old one is paid for, and from those who are asking for an extension of time.

Property Statement Forms.—To assist applicants for credit in preparing acceptable statements, property report forms have been prepared by the National Association of Credit Men,[1] and by the American Bankers' Association, as well as by several of the credit agencies.

Analysis of Property Statements.—One of the most useful acquisitions for the credit manager is the ability to analyze a balance sheet and an income account. It does little good to secure property statements, if one does not know when a statement is sufficiently full to be of value, nor how to discover inconsistencies. It is not the purpose of this discussion to digress into accounting: it must suffice to suggest a few of the more important points to be looked for.

Attention should first be given to current assets, and then to the relation of current assets to current liabilities: after that total assets may be considered in relation to total liabilities. This order of importance follows from two facts, first, that the misstatements in a balance sheet are more likely to be on the asset side than on the liability side, since it is easier (apart from fraudulent intent) to overstate the assets than to understate the liabilities, second, because the credit advance is to be limited to what can be repaid by the debtor's normal merchandising operations, rather than by the amount which a complete liquidation of his property, including his fixtures, real estate, and the like, will cover.

The general ratio of current assets to current liabilities should not at once be taken out of the balance sheet as the basis of judg-

[1] The Property Statement form here reproduced is presented with the Consent of the National Association of Credit Men

"Large assets are not always necessary to the creation of credit, what is most desirable is, that credit be in relative proportion to the actual assets"

PROPERTY STATEMENT

OF

TO

"The giver of credit is a contributor of capital, and becomes, in a certain sense, a partner of the debtor, and, as such, has a natural right to complete information of the debtor's condition at all times"

Form Adopted and Recommended by the National Association of Credit Men

For the purpose of obtaining *merchandise* from you on credit, we make the following statement in writing, intending that you should rely thereon respecting our financial condition as of (Date) 19

(All questions should be answered When no figures are inserted, write word "None")

ASSETS			LIABILITIES		
Cash in hand			For MERCHANDISE		
Cash in bank			Accounts owing not due		
Accounts owing by customers, good and collectible, not pledged or sold			Accounts owing past due		
Notes owing by customers, good and collectible, not pledged or sold			Trade Acceptances payable		
Trade Acceptances receivable, not pledged			Notes payable for Mdse.		
Merchandise (not in consignment or conditional sale) (How valued, Cost Market....)			For BORROWED MONEY.		
Other quick assets:			Notes payable to banks		
(Describe)			Notes or debts payable to others (including relatives and friends)		
			Deposits of money with us (Describe)		
			Owing for Wages and Salaries		
			Owing for Taxes (city, state and federal)		
			Owing for Rental		
			Owing for Insurance Premiums		
TOTAL QUICK ASSETS			TOTAL QUICK LIABILITIES		

Machinery: (How valued, Cost Depreciated .)			Debt secured by mortgage on land or buildings		
Fixtures and other Equipment. (How valued, Cost Depreciated)			Debt secured by chattel mortgage or other liens		
Land and Buildings as described below			Debt secured by judgment .		
Notes and Accounts owing from officers, employees, or others not customers			Other liabilities (Describe)		
Other assets (Describe)			TOTAL LIABILITIES		
			NET WORTH { Capital Stock { Preferred / Common		
			NET WORTH { Surplus and Undivided Profits . .		
TOTAL ASSETS			TOTAL		

What books of account do you keep?
Was this statement made from those books? Do you keep cost records?
Do you sell or pledge your accounts to creditors, banks, finance companies or others? If so, what amount is so sold or pledged? $ What amount of your accounts have you sold or pledged during the past twelve months? $
Are any creditors secured by mortgage or lien of any sort? If so, how?

Are any claims in attorneys' hands or suits against you?.
Have you merchandise on consignment or conditional sale? If so, what amount? $. .
If business property is leased, for what term and what rental?.
Name and locality of your bank or banks.
Location and kind of business.
Under the laws of what state is your business incorporated?
Previous business experience. Where

It is important that every question on both sides of this sheet be correctly answered and that the blanks be carefully filled in In answering questions involving amounts write the word 'none" where figures do not apply You will find it advantageous to keep a copy of this statement for comparison with the showing you will be able to make a year hence.

INSURANCE

On Merchandise $ . . . . On Buildings $. Machinery $ Fixtures $ . .

Other Equipment $ . . Employers' liability $ Do you carry Fidelity Bonds?.

Is any insurance assigned? . . . What amount? . . To whom?

Amount of life insurance for benefit of business $ . .

With what companies?. .

SUMMARY OF PROFIT AND LOSS

Inventory of Mdse beginning of fiscal year (not including fixtures or equipment)			Sales last fiscal year		
Cost of Mdse purchased during the year			Income from all other sources		
General expenses including salaries, losses, etc			Inventory of Mdse at close of year		
			Total Income for year		
			Less Total Expenses.		
TOTAL EXPENSES			NET PROFIT FOR YEAR. . .		

RECORD OF LAND AND BUILDINGS

Title in Name of	Description and Location	Book Value	Assessed Value	Amount of Encumbrances	To Whom

BUY PRINCIPALLY FROM THE FOLLOWING CONCERNS

Names	Addresses	Amount Owing	
		Open Account	Notes

Names and Addresses of Officers

REMARKS

The foregoing statement has been carefully read (both printed and written matter) and is in all respects complete, accurate and truthful It discloses to you the true state of our financial condition on the date above stated Since that time there has been no material unfavorable change in our financial condition, and if any such change takes place we will give you notice. Until such notice is given, you are to regard this as a continuing statement

Name of Corporation.

Signed by

(Designate office held)

Street Town State

Date of signing statement 19

ment. The individual items of which these totals are composed must first be scrutinized, one by one, and revised or conservatively discounted, before usable totals are available.

As to the item " cash," it is desirable that this be sufficient—say 20 per cent of loans—to command bank favor, partly cover items deposited drawn on outside points, and secure low rates of discount. A cushion of available cash will preserve the manager from strain and anxiety, for " he cannot expect his sales and collections to arrive on schedule time as do his notes, accounts and acceptances."

As for " accounts receivable," it may be asked, how much of them is old, and how much is pledged with banks or brokers for loans? The energy used in collecting will be shown by the ratio to sales.

Similar questions will arise with reference to " notes receivable." Here the paper growing out of normal merchandising operations is to be distinguished from that given by officers, employees, stockholders, relatives, and friends. These probably are the evidences of private relations which have been interjected into the finance of the business.

The item " merchandise " is a danger spot. It is difficult to be sure that the valuation is conservative. An experienced traveling salesman's estimate as to the apparent adequacy or inadequacy of every dealer's stock should be available to the credit man. It is to be remembered that it is only the equity above chattel mortgage claims, and only the merchandise owned, as distinguished from merchandise held on conditional sale or agency contract, which constitutes an asset to secure book accounts.

Among liabilities " accounts payable " are difficult to verify. An idea as to the total amount may be secured by a canvass of supplying houses. Here the comprehensive summaries made possible by the compilations of trade associations and credit clearing houses are of value.

" Notes payable " should be classified as those owing to banks, to brokers, to relatives, to supply houses, etc. The amount and distribution of these items will indicate the precautions taken by other creditors to secure evidences of indebtedness from the dealer. It is desirable, but difficult, to secure a complete account as to

contingent liabilities arising out of endorsements, guarantees, suits pending, and the like.

We now come to the ratio of current assets to current liabilities, which is the most important property test of the debtor. Mr. S. F. Brewster has quoted an authority on this ratio as follows: "Common practice has (as far as has been made public) developed only one general theory of extending commercial credit which has become accepted as more or less standard. This theory is known as the two-for-one rule, and consists of the principle that in order to establish a good credit proportion, the statement must show at least two dollars of current assets for every dollar of current liability. The reason for this measure is basically sound, because from a credit standpoint companies must be looked at, partially at least, as liquidating propositions, in which there is bound to be a shrinkage of assets, in that some accounts will be slow and bad, and some merchandise out of season and antiquated, whereas the corresponding debt is not subject to shrinkage" [1]

Back of the ratio between current assets and current liabilities lies the ratio between total assets and total liabilities, with the associated item of "net worth" which shows more fully the extent to which the debtor's property affords a margin of safety. In these are involved the fixed assets and the long-term obligations. Fixed assets are only of value to the extent of the equity over and above tax liens, mortgages, dowry rights, and homestead and personal exemptions.

The income, or profit and loss, account is to be examined, first of all, to ascertain the amount of the annual net sales (sales less returns). From this figure the credit man can derive an idea as to whether or not the debtor has achieved a business of competent size; and as to what the probable influence of fixed charges is upon his net profits. By comparing sales with expenses, the cost of doing business will be revealed. This figure the credit manager should consider in relation to standards of average practice and standards of good practice. The Bureau of Business Research of Harvard University, in 1922 discovered the financial situation in the retail grocery and the retail shoe trades to be as indicated in

[1] Legal Aspects of Credit, S. F. Brewster, N. Y., 1923. Ronald Press, p 129.

the tabulation here reproduced.[1] All figures, except those of the number of stores, are percentages of net sales

Annual Sales 1922	Less than $30,000	$30,000-49,000	$50,000-99,000	$100,000-249,000	$250,000 and Over
Retail Shoe Stores	101	102	105	67	46
Total expenses. .	28 3	27 0	27 3	28 5	31 2
Gross margin	25 4	26 9	28 7	29 6	32 7
Profit or loss.. . .	2 9 Loss	0 1 Loss	1 4 Profit	1 1 Profit	1 5 Profit
Retail Grocery Stores	64	101	160	60	58
Total expenses.....	19 9	17 7	17.4	17 7	18 5
Gross margin...	20 3	18 5	18.9	20 0	20 1
Net profit .	0 4	0 8	1.5	2 3	1 6

In 1919 the total expenses in 187 retail drug stores were found, by the Harvard Bureau, to be 27.6 per cent of sales the gross margin was 34 per cent, and the profit 6.3 per cent.[2] In the same year, the total expenses in 155 retail hardware stores were found to be 21 per cent of sales: while the gross margin was 27.1 per cent, and the profit 5 8 per cent.[3] By the comparison of the income accounts of a series of years, the credit manager can ascertain the general trends as to sales, expenses, and profits, and so can ascertain whether the dealer is making normal progress, is standing still, or is falling behind.

[1] Management Problems in Retail Grocery Stores, Cambridge, Mass. Bureau of Business Research, Harvard University Operating Expenses in Retail Shoe Stores in 1922, Cambridge, Mass. Bureau of Business Research, Harvard University See also Principles of Merchandising, M. T Copeland, Chicago, 1925. A W Shaw Co, pp 36 and 108

[2] Operating Expenses in Retail Drug Stores in 1919 Cambridge, Mass. Bureau of Business Research, Harvard University Republished in Principles of Merchandising, M. T Copeland, Chicago, 1925 A W Shaw Co, p 40.

[3] Operating Expenses in Retail Hardware Stores in 1919 Cambridge, Mass Bureau of Business Research, Harvard University Reprinted in Copeland, p 38

When the sales and expenses of a business can be compared with the total credit advances made to it, the proper term of the credits can be calculated. If a firm makes annual sales of $100,000 with expenses of $20,000, and so has a sum of $80,000 applicable to debts, the payment of claims should proceed at the rate of $222.22 per day, if the entire amount is applied. If the debts average $25,000 this would mean that, where an even rotation was observed, any particular account should be paid in 112 days. If then an account stands longer, the delay suggests that there is either favoritism, increase of indebtedness, or diversion of funds.

The Credit Office.—The office system of the credit department is directed to the systematic recording of items of information bearing upon the credit standing of customers, and to the rapid review of the purchase orders received, in the light of this information. The office procedure should be designed to bring customers' accounts to the attention of the credit man as infallibly as possible upon the occurrence of certain designated junctures which are deemed dangerous.

Among such junctures are.

(*a*) Line of credit used up
(*b*) Account overdue
(*c*) Refusal to honor draft
(*d*) An unearned cash discount taken
(*e*) Refusal to pay interest on overdue account.
(*f*) Defective remittance, such as a check short in amount, but marked "Payment in full"
(*g*) Refusal to furnish financial statement
(*h*) Rapid increase in orders above previous average
(*i*) An unusually large order, placed by a slow-pay customer, who has recently been paying very promptly
(*j*) A claim as to shortage or damage or defective quality, tardily presented, and under circumstances which are not convincing; especially a succession of such claims.
(*k*) A claim, not warranted by the contract of sale, for arbitration (or the return of merchandise for credit) especially, after a decline of prices
(*l*) Cancellation of orders, when not the custom of the trade
(*m*) Fire under suspicious circumstances, especially a second or third fire
(*n*) Report of unfavorable items of legal record

Collections

An account is a collection from the time the bill of goods is charged against a customer on the ledger; at least in the sense that, from the time when patronage on credit begins, the credit office should compile information which may be of use at any stage in the life of the account.

The Stages of a Collection.—The history of a collection may be represented as a series of steps:

1. A statement should be presented at maturity. It is customary among many classes of merchants to collect individual items into monthly statements; manufacturers, on the other hand, generally present each invoice as a separate bill.

2. A statement disregarded should be promptly followed by a firm and candid follow-up. Promptness not only avoids a portion of the labor of watching accounts, and saves the interest and business profit of the funds otherwise locked up, but it allows less time for unfavorable changes to occur in the debtor's affairs. It is a mistaken analysis to assume that a customer's patronage is held by letting an old debt drag. Debtors who feel that they have overtaxed a creditor's generosity avoid contact, fearing a dun. They are more comfortable with a new concern where their credit is temporarily better. Debts long postponed are notoriously hard to pay. During the delay the debtor enjoys the use of the property of another, and this false situation gradually breaks down his value sense. The longer he remains in this comfortable state, the more disagreeable, and finally even unfair, it seems to him to be obliged to change.

3. The use of a sight draft is a recognized process of collecting, and one which should give no offense, provided it is known that a house makes a practice of using it regularly. A draft should preferably be presented through the bank with which the customer deals in his own town. It will, in such a case, be less willingly dishonored; and it will be in the hands of the bank most disposed to grant financial assistance.

4. A dishonored draft brings a collection to a critical point, where thorough investigation is needed before taking further steps. Investigation may lead to any one of several courses of action: (*a*) An extension of time may be granted, coupled, if pos-

sible, with partial payment and, in some cases, by the obtaining of security. A series of notes may be arranged to fall due at intervals. "More men will meet promptly three small payments with intervals of time between than the aggregate of the payments at the average time. The dealer usually must lay by money in advance to meet a considerable payment, and there is always danger that he will use this fund for some other purpose, either to make purchases which are urged upon him, or to satisfy some intervening creditor." (b) An account may be transferred to a collection agency if the credit department is not strong. (c) The last stage of a collection lands it either in the hands of an attorney, or in the list of bad debts charged up to profit and loss.

5. The entrance of an attorney ends amicable relations. All collection efforts short of suit should, therefore, be made before an account is placed in the hands of an attorney. This is equivalent to saying that the use of an attorney in prolonged efforts at collection is a mistake. An attorney should demand settlement or security; if neither is forthcoming, suit should be begun or the matter finally dropped.

Credit Adjustment Bureaus.—When an insolvent business is to be liquidated for the benefit of creditors, under the provisions of the bankruptcy act, the procedure is, after the filing of a petition, to appoint a receiver, adjudge the debtor a bankrupt, prepare lists of the creditors and of the debtor's assets, elect a trustee, collect the assets and convert them into cash, establish proof of the debts, declare dividends, and grant a certificate of discharge to the debtor. This law is most valuable. It is responsible for the fact that the former wild scramble of creditors to get ahead of each other in filing attachments on debtor's property no longer takes place. It is responsible also for the further fact that transfers of property intended to defraud creditors or favor certain of them at the expense of others are largely decreased. Nevertheless, the operations of receivers in taking temporary charge of bankrupt estates, and of trustees in collecting and reducing to money the property of bankrupts, are usually performed by young attorneys who are ignorant of business methods, or by business men whose own affairs have not prospered sufficiently to fully occupy them, and hence are frequently marked by waste

and delays and the use of value-destroying methods of liquidation. It is a general opinion among credit officers that bankruptcy proceedings result in destroying one-third of the value of the assets involved, and in paying to creditors thirty-three and one-third cents on the dollar, or less.

To avoid as much as possible of these losses and expenses, the members of the National Credit Men's Association have organized, in many cities, credit adjustment bureaus, which undertake to act as trustees representing creditors, and to liquidate property in an expert manner, with the use of the most approved mercantile methods. As a general rule, these bureaus are able to distribute to creditors somewhat more than fifty cents on the dollar.

Credit Insurance.—Credit insurance is better described by the English title, "Excess bad debt insurance." It is a form of insurance offered to cover unusual losses in collection. In taking out a policy the average bad debt loss of the insured firm is calculated for a period of five years last preceding. This percentage is set down as the own or initial loss and is not covered by the insurance. Losses on accounts above this percentage which result from the insolvency of the debtor are then divided into two classes: first, those involving customers who had, at the time the credit was extended, a capital and first or second-grade credit rating in the books of an agreed mercantile agency and, second, losses on customers not having such ratings. Losses on rated customers are covered in full by the policy, except that the sum insured on any one account is not to exceed a specified sum. Losses on customers without ratings are partly insured, that is to say, the company purchasing the policy becomes co-insurer with the insurance company in respect to such losses. Some of the advantages claimed for this form of indemnity are (*a*) that a known premium replaces an unknown loss, so that an offsetting charge can be inserted in price; (*b*) that trial balances can show the actual value of accounts receivable; (*c*) that credit accounts are made a more acceptable collateral for bank loans; (*d*) that the maximum amount insurable for any individual account can be used as the credit limit with customers without offending them.

PROBLEMS

Property Statement.—What danger signals are to be found in the following statement made by a firm on January 29, 1923? The President of this company was arrested on Federal perjury charge on March 6, 1924.

Assets		*Liabilities*	
Merchandise	$3,560.70	Capital stock issued	$10,044 23
Accounts	1,214.30		
Notes	1,850 00		
Cash	3,419.23		
Total	$10,044 23	Total	$10,044 23

A Second Property Statement.—Is there anything to object to in the following property statement, by reason of which a credit manager might desire to make further investigation before granting credit?

Assets		*Liabilities*	
Stock on hand	$10,000 00	For Merchandise and trade acceptances	$5,600 00
Outstanding accounts	7,000.00	Surplus in business	12,600 00
Stocks and Liberty bonds	1,200 00		
Total	$18,200.00	Total	$18,200.00

In addition to this statement, the merchant mentioned owning some real estate, without giving a value He stated that his annual turnover was $50,000 and his annual expenses $16,000

A Third Property Statement.—Criticise the following statement made by a wholesale grocery concern.

Assets		*Liabilities*	
Cash	$406,826.32	Bills payable.	$1,100,000.00
Accounts receivable	1,806,715.14	Accounts payable	206,530 45
Merchandise	1,783,945.60	Money on deposit	723,942.19
Real Estate	1,643,000 00	First Mtg. bonds	1,500,000 00
Machinery, wagons, trucks	157,435 00	Preferred stock	1,500,000 00
Good will	1,000,000 00	Common stock	1,000,000 00
		Surplus	767,449 42
Total	$6,797,922.06	Total	$6,797,922 06

What additional information, if any, would you desire, if you were a banker, and this corporation had applied to you for a loan of several

hundred thousand dollars, to be made on unsecured notes of the corporation? On the present showing could any objection be made to such a loan?

A Fourth Property Statement.—A merchant gave the following verbal property statement on Nov. 15, 1923.

Assets		*Liabilities*	
Cash in bank	$ 200 00	For merchandise	$4,000 00
Accounts receivable	4,000 00	Surplus	10,300.00
Fixtures	100 00		
Stock in trade.	10,000.00		
Total	$14,300.00	Total	$14,300.00

On May 5, 1923, the merchant gave the following verbal statement

Assets		*Liabilities*	
Cash in bank	$350 00	For merchandise	$5,000 00
Accounts receivable	5,000.00	Loan from bank	3,000 00
Fixtures	1,000 00	Surplus in business	13,350.00
Stock	15,000 00		
Total	$21,350 00	Total	$21,350.00

What is there, if anything, in this record to excite suspicion, or to call for further investigation before granting a merchandise credit?

The Reports of Financial Agencies.—Secure sample reports from various financial services, such as The Harvard Economic Service, Cambridge, Mass., The Brookmire Economic Service, 25 W. 45th St., N. Y C., The Business Conditions Service, Alexander Hamilton Institute, Astor Place, N. Y. C., Moody's Investor's Service, 35 Nassau St., N Y. C., Babson Statistical Organization, Wellesley Hills, Mass., and others Examine these reports and show how they may be made of use to the credit manager in determining general credit policies.

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AMOUNT OF 1 AT COMPOUND INTEREST

Periods	2%	2½%	3%	3½%	4%	5%	6%	7%	8%
1	1 02	1 025	1 03	1 035	1 04	1 05	1 06	1 07	1 08
2	1 0404	1 05063	1 0609	1 07123	1 0816	1 1025	1 1236	1 1449	1 1664
3	1 06121	1 07689	1 09727	1 10872	1 12486	1 15763	1 19102	1 22504	1 25971
4	1 08243	1 10381	1 12551	1 14752	1 16986	1 21551	1 26248	1 31080	1 36049
5	1 10408	1 13141	1 15927	1 18769	1 21665	1 27628	1 33822	1 40255	1 46933
6	1 12616	1 15969	1 19405	1 22926	1 26532	1 34010	1 41852	1 50073	1 58687
7	1 14869	1 18869	1 22987	1 27228	1 31593	1 40710	1 50363	1 60578	1 71382
8	1 17166	1 21840	1 26677	1 31681	1 36857	1 47746	1 59385	1 71819	1 85093
9	1 19509	1 24886	1 30477	1 36290	1 42331	1 55133	1 68948	1 83846	1 99900
10	1 21900	1 28008	1 34392	1 41060	1 48024	1 62890	1 79085	1 96715	2 15893
11	1 24337	1 31209	1 38423	1 45997	1 53945	1 71034	1 89830	2 10485	2 33164
12	1 26824	1 34489	1 42576	1 51107	1 60103	1 79586	2 01220	2 25219	2 51817
13	1 29361	1 37851	1 46853	1 56396	1 66507	1 88565	2 13293	2 40985	2.71962
14	1 31948	1 41297	1 51259	1 61869	1 73168	1 97993	2 26090	2 57853	2 93719
15	1 34587	1 44830	1 55797	1.67535	1 80094	2 07893	2 39656	2 75903	3 17217
16	1 37279	1 48451	1 60471	1 73399	1 87298	2 18287	2 54035	2 95216	3 42594
17	1 40024	1 52162	1 65285	1 79468	1 94790	2 29202	2 69277	3 15882	3 70002
18	1 42825	1 55966	1 70243	1 85749	2 02582	2 40662	2 87434	3 37993	3 99602
19	1 45681	1 59865	1 75351	1 92250	2 10685	2 52695	3 02560	3 61653	4 31570
20	1 48595	1 63862	1 80611	1 98979	2 19112	2 65330	3 20714	3 86968	4 66096
21	1 51567	1 67958	1 86029	2 05943	2 27877	2 78596	3 39956	4 14056	5 03383
22	1 54598	1 72157	1 91610	2 13151	2 36992	2 92526	3 60354	4 43040	5 43654
23	1 57690	1 76461	1 97359	2 20611	2 46472	3 07152	3 81975	4 74053	5 87146
24	1 60844	1 80873	2 03279	2 28333	2 56330	3 22510	4 04893	5 07237	6 34118
25	1 64061	1 85394	2 09378	2 36324	2 66584	3 38635	4 29187	5 42743	6 84848
26	1 67342	1 90029	2 15659	2 44596	2 77247	3 55567	4 54938	5 80735	7 39635
27	1 70689	1 94780	2 22129	2 53157	2 88337	3 73346	4 82235	6 21387	7 98806
28	1 74102	1 99650	2 28793	2 62017	2 99870	3 92013	5 11169	6 64884	8 62711
29	1 77584	2 04641	2 35657	2 71188	3 11865	4 11614	5 41839	7 11426	9 31727
30	1 81136	2 09757	2 42726	2 80679	3 24340	4 32194	5 74349	7 61226	10 06266
31	1.84759	2 15001	2 50009	2 90503	3 37313	4 53804	6 08810	8 14511	10 86767
32	1 88454	2 20376	2 57508	3 00671	3 50806	4 76494	6 45339	8 71527	11 73708
33	1 92223	2 25885	2 65234	3 11194	3 64838	5 00319	6 84059	9 32534	12 67605
34	1 96068	2 31532	2 73191	3 22086	3 79432	5 25335	7 25103	9 97811	13 69013
35	1 99989	2 37321	2 81386	3 33359	3 94609	5 51602	7 68609	10 67658	14 78534
36	2 03989	2 43254	2 89828	3 45027	4 10393	5 79182	8 14725	11 42394	15 96817
37	2 08069	2 49335	2 98523	3 57103	4 26809	6 08141	8 63609	12 22362	17 24563
38	2 12230	2 55568	3 07478	3 69601	4 43881	6 38548	9 15425	13 07927	18 62528
39	2 16474	2 61957	3 16703	3 82537	4 61637	6 70475	9 70351	13 99482	20 11530
40	2 20804	2 68506	3 26204	4 95926	4 80102	7 03999	10 28572	14 97446	21 72452

PRESENT WORTH OF 1 AT COMPOUND INTEREST

Periods	2%	2½%	3%	3½%	4%	5%	6%	6%	8%
1	0 98039	0 97561	0 97087	0 96618	0 96154	0 95238	0 94340	0 93458	0 93593
2	96117	95181	94260	93351	92456	90703	.89000	87344	85734
3	94232	92856	91514	90192	88900	86384	83962	81630	79383
4	92385	90595	88849	.87144	85480	82270	79209	76290	73503
5	90573	88385	86261	84197	82193	78353	74726	71299	68058
6	88797	86230	83748	81350	79031	74621	70496	66634	63017
7	87056	84127	81309	78600	75992	71068	66506	62275	58349
8	85349	82075	78941	75941	73069	67684	62741	58201	54027
9	83676	80073	76642	73373	70259	64461	59190	54393	50025
10	82035	78120	74409	70892	67556	61391	.55839	.50835	46319
11	80426	76214	.72242	68495	64958	58468	52679	47509	42888
12	78819	74356	70138	66178	62460	.55684	49697	44401	39711
13	77303	72542	68095	63940	60057	53032	.46884	41496	36770
14	75788	.70773	66112	61778	57748	50507	44230	38782	34046
15	74301	69047	64186	59689	55526	48102	41727	36245	31524
16	72845	67362	.62317	57671	53391	45811	39365	33873	29189
17	71416	65720	60511	55720	51337	43630	37136	31657	27027
18	70016	64117	58739	53836	49363	41552	35034	29586	25025
19	68643	62553	57029	52016	47464	39573	33051	27651	23171
20	67297	61027	.55368	50257	45639	37689	31180	25842	21455
21	65978	.59539	53755	48557	43883	35894	29416	24151	19866
22	64684	58086	52189	46915	42196	34185	27751	22571	18394
23	63416	.56670	.50669	.45329	40573	.32557	26180	.21095	17032
24	62172	55288	.49193	43796	39012	31007	24698	19715	15770
25	60953	53939	.47761	42315	37512	29530	23300	.18425	14602
26	59758	.52623	46369	.40884	36069	28124	21981	17220	13520
27	.58586	51340	45019	39501	.34682	26785	20737	16093	.12519
28	57437	.50088	43708	38165	33348	25509	.19563	15040	11591
29	56311	.48866	42435	36875	32065	.24295	18456	14056	10733
30	55207	47674	41199	35628	.30832	23138	17411	.13137	09938
31	54125	46511	39999	34423	29646	22036	16425	12277	09202
32	53063	45377	38834	33259	28506	20987	.15496	11474	08520
33	52023	44270	37703	32134	.27409	19987	.14619	.10723	07889
34	51003	43191	36604	31048	26355	19035	13791	10022	07305
35	50003	42137	.35538	29998	25342	18129	.13011	09366	06763
36	49022	.41109	34503	28983	24367	17266	.12274	08754	06262
37	48061	40107	33498	28003	23430	16444	11579	08181	05799
38	47119	39128	32523	27056	22529	15661	10924	07646	05369
39	.46195	38174	31575	26141	21662	14915	10306	07146	04971
40	45290	37243	30656	.25257	20830	14205	09722	06678	04603

AMOUNT OF 1 PER ANNUM, PAID AT THE END OF EACH PERIOD

Periods	2%	2½%	3%	3½%	4%	5%	6%	7%	8%
1	1	1	1	1	1	1	1	1	1
2	2 02	2 025	2 03	2 035	2 04	2 05	2 06	2 07	2 08
3	3 0604	3 07563	3 0909	3 10623	3 1216	3 1525	3 1836	3 21490	3 24640
4	4 12161	4 15252	4 18363	4 21494	4 24646	4 31013	4 37462	4 43994	4 50611
5	5 20404	5 25633	5 30914	5 36247	5 41632	5 52563	5 63709	5 75074	5 86660
6	6 30812	6 38774	6 46841	6 55015	6 63298	6 80191	6 97532	7 15329	7 33593
7	7 43428	7 54743	7 66246	7 77941	7 89829	8 14201	8 39384	8 65402	8 92280
8	8 58297	8 73612	8 89234	9 05169	9 21423	9 54911	9 89747	10 25980	10.63663
9	9 75463	9 95452	10 15911	10 36850	10 58280	11 02656	11 49132	11 97799	12 48756
10	10 94972	11 20338	11 46388	11 73139	12 00611	12 57789	13 18079	13 81645	14 48656
11	12 16872	12 48347	12 80780	13 14199	13 48635	14 20679	14 97164	15 78360	16 64549
12	13 41209	13 79555	14 19203	14 60196	15 02581	15 91713	16 86994	17 88845	18 97713
13	14 68033	15 14044	15 61779	15 11303	16 62684	17 71298	18 88214	20 14064	21 49530
14	15 97394	16 51895	17 08632	17 67699	18 29191	19 59863	21 01507	22 55049	24 21492
15	17 29342	17 93193	18 59891	19 29568	20 02359	21 57856	23 27597	25 12902	27 15211
16	18 63929	19 38022	20 15688	20 97103	21 82453	23 65749	25 67253	27 88805	30 32428
17	20 01207	20 86473	21 76159	22 70502	23 69751	25 84037	28 21288	30 84022	33 75023
18	21 41231	22 38635	23 41444	24 49969	25 64541	28 13238	30 90565	33 99903	37 45024
19	22 84056	23 94601	25 11687	26 35718	27 67123	30 53900	33 75999	37 37896	41 44626
20	24 29737	25 54466	26 87037	28 27968	29 77808	33 06595	36 78559	40 99549	45 76196
21	25 78332	27 18327	28 67649	30 26947	31 96920	35 71925	39 99273	44 86518	50 42292
22	27 29899	28 86286	30 53678	32 32890	34 24797	38 50521	43 39229	49 00574	55 45376
23	28 84496	30 58443	32 45288	34 46041	36 61789	41 43048	46 99583	53 43614	60 89330
24	30 42186	32 34904	34 42647	36 66553	39 08260	44 50200	50 81558	58 17667	66 76476
25	32 03030	34 15776	36 45926	38 94986	41 64591	47 72710	54 86451	63 24904	73 10594
26	33 67091	36 01171	38 55304	41 31310	44 31774	51 11345	59 15638	68 67647	79 95442
27	35 34432	37 91200	40 70963	43 75906	47 08421	54 66913	63 70577	74 48382	87 35077
28	37 05121	39 85980	42 93092	46 29063	49 96758	58 40258	68 52811	80 69769	95 33883
29	38 79223	41 85630	45 21885	48 91080	52 96629	62 33271	73 63980	87 34653	103 96594
30	40 56808	43 90270	47 57542	51 62268	56 08494	66 43885	79 05819	94 46079	113 28321
31	42 37944	46 00027	50 00268	54 42947	59 32834	70 76079	84 80168	102 07304	123 34587
32	44 22703	48 15028	52 50276	57 33450	62 70147	75 29883	90 88978	110 21815	134 21354
33	46 11157	50 35403	55 07784	60 34121	66 20953	80 06377	97 34316	118 93343	145 95062
34	48 03380	52 61289	57 73018	63 45315	69 85791	85 06696	104 18375	128 25876	158 62667
35	49 99448	54 92821	60 46208	66 67401	73 65222	90 32031	111 43478	138 23688	172 31680
36	51 99437	57 30141	63 27594	70 00760	77 59831	95 83632	119 12087	148 91346	187 10215
37	54 03425	59 73395	66 17422	73 45787	81 70225	101 62814	127 26812	160 33740	203 07032
38	56 11494	62 22730	69 15945	77 02890	85 97034	107 70955	135 90421	172 56102	220 31595
39	58 23724	64 78298	72 23423	80 72491	90 40915	114 09502	145 05846	185 64029	238 94122
40	60 40199	67 40256	75 40126	84 55028	95 02552	120 79977	154 76197	199 63511	259 05652

PRESENT WORTH OF 1 PER ANNUM, PAID AT THE END OF EACH PERIOD

Periods	2%	2½%	3%	3½%	4%	5%	6%	7 %	8%
1	0 98039	0 97561	0 97087	0 96618	0 96154	0 95238	0 94340	0 93458	0 92593
2	1 94156	1 92742	1 91347	1 89969	1 88609	1 85941	1 83339	1 80802	1 78326
3	2 88388	2 85602	2 82861	2 80164	2 77509	2 72325	2 67301	2 62432	2 57710
4	3 80773	3 76197	3 71710	3 67308	3 62990	3 54595	3 46511	3 38721	3 31213
5	4 71346	4 64583	4 57971	4 51505	4 45182	4 32948	4 21236	4 10020	3 99271
6	5 60143	5 50813	5 41719	5 32855	5 24214	5 07569	4 91732	4 76654	4 62288
7	6 47199	6 34939	6 23028	6 11454	6 00205	5 78637	5 58238	5 38929	5 20637
8	7 32548	7 17014	7 01969	6 87396	6 73274	6 46321	6 20979	5 97130	5 74664
9	8 16224	7 97087	7 78611	7 60769	7 43533	7 10782	6 80169	6 51523	6 24689
10	8 98259	8 75206	8 53020	8 31661	8 11090	7 72174	7 36009	7 02358	6 71008
11	9 78685	9 51421	9 25262	9 00155	8 76048	8 30641	7 88687	7 40867	7 13896
12	10 57534	10 25776	9 95400	9 66333	9 38507	8 86325	8 38384	7 94269	7 53308
13	11 34837	10 98318	10 63496	10 30274	9 98565	9 39357	8 85268	8 35765	7 90378
14	12 10625	11 69091	11 29607	10 92052	10 56312	9 89864	9 29498	8 74547	8 24424
15	12 84926	12 38138	11 93794	11 51741	11 11839	10 37966	9 71225	9 10791	8 55948
16	13 57771	13 05500	12 56110	12 09412	11 65230	10 83777	10 10590	9 44665	8 85137
17	14 29187	13 71220	13 16612	12 65132	12 16567	11 27407	10 47726	9 76322	9 12164
18	14 99203	14 35336	13 75351	13 18968	12 65930	11 68959	10 82760	10 05909	9 37189
19	15 67846	14 97889	14 32380	13 70984	13 13394	12 08532	11 15812	10 33560	9 60360
20	16 35143	15 58916	14 87747	14 21240	13 59033	12 46221	11 46992	10 59401	9 81815
21	17 01121	16 18455	15 41502	14 69797	14 02916	12 82115	11 76408	10 83553	10 01681
22	17 65805	16 76541	15 93692	15 16712	14 45112	13 16300	12 04158	11 06124	10 20074
23	18 29220	17 33211	16 44361	15 62041	14 85684	13 48857	12 30338	11 27219	10 37106
24	18 91393	17 88499	16 93554	16 05837	15 24696	13 79864	12 55036	11 46933	10 52876
25	19 52346	18 42438	17 41315	16 48151	15 62208	14 09394	12 78336	11 65358	10 67478
26	20 12104	18 95061	17 87684	16 89035	15 98277	14 37519	13 00317	11 82578	10 80998
27	20 70690	19 46401	18 32703	17 28536	16 32959	14 64303	13 21053	11 98671	10 93516
28	21 28127	19 96489	18 76411	17 66702	16 66306	14 89813	13 40616	12 13711	11 05108
29	21 84438	20 45355	19 18845	18 03577	16 98371	15 14107	13 59072	12 27767	11 15841
30	22 39646	20 93030	19 60044	18 39205	17 29203	15 37245	13 76483	12 40904	11 25778
31	22 93770	21 39541	20 00043	18 73628	17 58849	15 59281	13 92909	12 53181	11 34980
32	23 46833	21 84918	20 38877	19 06887	17 87355	15 80268	14 08404	12 64656	11 43500
33	23 98856	22 29988	20 76579	19 39021	18 14765	16 00255	14 23023	12 75379	11 51389
34	24 49859	22 72379	21 13184	19 70068	18 41120	16 19290	14 36814	12 85401	11 58693
35	24 99862	23 14516	21 48722	20 00066	18 66461	16 37419	14 49825	12 94767	11 65457
36	25 48884	23 55625	21 83225	20 29049	18 90828	16 54685	14 62099	13 03521	11 71719
37	25 96945	23 95732	22 16724	20 57053	19 14258	16 71129	14 73678	13 11702	11 77518
38	26 44064	24 34860	22 49246	20 84109	19 36786	16 86790	14 84602	13 19347	11 82887
39	26 90259	24 73034	22 80822	21 10246	19 58448	17 01704	14 94907	13 26493	11 87858
40	27 35548	25 10278	23 11477	21 35507	19 79277	17 15909	15 04630	13 33171	11 92461

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